

# **The impacts of a health education programme on primary school teachers' knowledge and attitudes towards type 1 diabetes mellitus in children in Saudi Arabia**

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**Buthaina Aljehany**

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## **ABSTRACT**

### **Introduction**

The incidence of T1DM in the Kingdom of Saudi Arabia (KSA) is particularly high at 36.99 per 100,000. The number of newly diagnosed cases in children (0-14 years) is estimated at 10,700 per year, constituting a major public health problem. Schools are important for secondary prevention, treatment and management of Type 1 Diabetes Mellitus (T1DM). Teachers need to be knowledgeable about diabetic emergencies.

### **Aim**

The aim of this study was to assess the impact of a health education programme on primary school teachers' knowledge and attitudes towards T1DM in children attending schools in Jeddah City, KSA.

### **Methods**

A repeated measures non-equivalent groups design was adopted, with testing of the teachers at baseline, three month, and six month stages. Data was collected from 2013 to 2014. A structured, self-administered questionnaire was employed in Arabic. A total of 540 teachers were recruited in equal numbers by gender, of which 318 completed all test stages. The intervention consisted of a new and specially designed educational programme comprised of lectures and activities, with additional reading materials. SPSS was used for quantitative analysis of the data, and paired samples t-test and ANOVA were used to test for differences within and between experimental and control groups.

### **Results**

No significant differences were found at the baseline pre-test stage between the groups in teachers' knowledge of T1DM in children, or their attitudes towards managing T1DM. The mean knowledge scores in the experimental group increased significantly at the post-test stage (three months), and again at the post-test 2 stage (six months). The mean knowledge scores of the control group fluctuated to some extent at the post-test and post-test 2 stages. The mean attitude scores in the experimental group showed significant increases at the post-test and post-test 2 stages, but there was no significant change in the mean attitude scores of the control group.

### **Conclusion**

The results clearly demonstrate the effectiveness of the intervention in improving teachers' knowledge and attitudes about managing T1DM in schools. The inexpensive programme could be integrated into the Saudi national child health programme, and policy and practice recommendations are proposed to the Ministry of Education.

## **ABBREVIATIONS**

AADE	American Association of Diabetes Educators
ADA	American Diabetes Association
ADSA	Americans with Disabilities Act 1990
ANOVA	Analysis of Variance
BED	Binge-Eating Disorder
BN	Bulimia Nervosa
BPS	British Psychological Society
CASP	Critical Appraisal Skills Programme
CDSI	Central Department of Statistical Information
CI	Confidence Interval
CMV	Cytomegalovirus
CPD	Continuing Professional Development
CRD	Centre for Reviews and Dissemination
DCCT	Diabetes Control and Complications Trial
Diabetes	Diabetes Mellitus
DKA	Diabetic Ketoacidosis
FPG	Fasting Plasma Glucose
GCC	Gulf Cooperation Countries
HbA1c	Glycosylated Haemoglobin
IDEA	Individuals with Disabilities Education Act 1990
IDF	International Diabetes Federation
IGT	Impaired Glucose Tolerance
JDF	Juvenile Diabetes Foundation
KSA	Kingdom of Saudi Arabia
MENA	Middle East and North Africa
OGTT	Oral Glucose Tolerance Test
PPR	Policy and Practice Recommendations
RPGT	Random Plasma Glucose Tolerance Test
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus

UAE	United Arab Emirates
UK	United Kingdom
USA	United States of America
WHO	World Health Organization



## **CHAPTER 1**

### **INTRODUCTION**

#### **A BACKGROUND TO DIABETES MELLITUS IN SCHOOLS**

There can be no doubt that children living with Type 1 Diabetes Mellitus (T1DM), wherever they are in the world, will find it difficult to successfully adapt to their condition. At an age when they are young and carefree and should be having fun and enjoying themselves, they may instead find themselves being overwhelmed because of their need to continuously monitor their underlying condition. A lifelong commitment to monitoring and regulating blood sugar levels through a range of insulin therapy treatments is not easy for a child to adapt to. Moreover, they may constantly find themselves feeling isolated and different to other children who may freely eat sweets, soft drinks, cakes and chocolates, and who can undertake a wide range of physical sports and activities. Instead, children with T1DM may find themselves constantly having to watch what they eat and drink, when they eat and drink, and also having to regularly monitor their blood sugar levels and the physical activities they undertake. Indeed, controlling T1DM may be a particularly daunting challenge for children, and may induce feelings of anxiety, worry, or even helplessness. The help and support provided by family, friends, and in particular the school environment, can make all the difference to how children living with T1DM cope in their daily lives.

Primary school teachers occupy the role of the main carers of children in school. This caring role becomes all the more important when some of the children in their care have serious medical conditions. In such circumstances, as is the case with children living with T1DM, teachers have the potential to exert positive impacts on the care of children. Consequently, the development and implementation of health education programmes for the effective management of T1DM within the school can assist teachers. Such programmes can ensure that the teachers have sufficient knowledge of the condition, and positive attitudes to support effectively and, if necessary, provide care for children with T1DM during school hours. The responsibility for managing children's diabetes mellitus (diabetes) rests with teachers as well as parents. This is because during term-time children spend between six and eight hours per day at school. Accordingly, schools are considered to be important locations for treatment and management of T1DM, with the aim of minimising the

adverse effects of its complications, or postponing their onset (Melton and Henderson, 2007).

Teachers' knowledge and attitudes towards T1DM are of paramount importance when dealing with T1DM in schools. T1DM in young people is most likely observed in middle and high school children. Sometimes children do not receive proper support due to lack of school teachers' knowledge about their condition (Alnasir, 2003). Children with diabetes need more support during and after school hours. This support can be provided by school staff and school teachers. The recommended way for improving this support has been to enable children's communication with school staff about their diabetes (Nabors *et al.*, 2005). Children with diabetes are required to check their blood glucose level periodically and need to manage their food intake on a daily basis. It is therefore important that school staff have knowledge about these activities and requirements, such as a diet plan for school lunches and physical activities during school hours. School teachers need to make active efforts to improve the management of T1DM in children at school by interacting with children, as well as their parents, and discussing options for effective management (Freeborn *et al.*, 2013).

Diabetes, which includes both T1DM and Type 2 Diabetes Mellitus (T2DM), has been implicated in a number of serious diseases and complications such as kidney disease, eye disease, and even nerve damage. These complications lower the quality of life for children with diabetes significantly, and some of these problems may even be life-threatening. Treatment of such diabetes-linked diseases constitutes a massive drain of resources and a heavy financial burden. The burden is not simply limited to the families of affected children, but also impacts wider society as primary health and other state services are utilised in the prevention, treatment and management of diabetes. For example, in the United Kingdom (UK) it is estimated that 10% of the NHS budget is spent on diabetes (Diabetes UK, 2014).

A report entitled 'Diabetes in the NHS' estimated a total cost of £3.5 billion per annum (Diabetes UK, 2014). In the United States of America (USA), treatment of diabetes represents a substantial economic burden, consuming 14% of the USA's total health expenditure. In the Kingdom of Saudi Arabia (KSA) expenditure on diabetes alone consumes 21% of the country's total health budget (Farag and Gaballa, 2011). The

projected cost of diabetes in the KSA for 2015 was \$2.4 billion, and this figure is expected to increase to \$6.5 billion by 2020 (Alhowaish, 2013). At that point in time the number of people diagnosed with diabetes in the KSA is expected to reach 7 million (Alhowaish, 2013).

## **PREVALENCE AND INCIDENCE OF DIABETES**

The term 'prevalence' is a measurement of how many people in a certain population have a disease at any one time, including anyone who has been recorded as being diagnosed in previous years. The term 'incidence' measures the number of people in a certain area that are newly diagnosed with the disease during a particular period of time, usually in one year. Whilst prevalence measures how common the disease is, incidence is a measure of the dynamics of the disease occurring in a population. References to incidence in the literature on diabetes typically refer to reported cases per 100,000, whereas references to prevalence are more often reported as a percentage of the population (although they may sometimes refer to cases per 100,000). For example, Alherbish *et al.* (2008) reported that the prevalence of T1DM in the KSA for those below the age of 19 years is 109 per 100,000. This should be read in conjunction with what the World Health Organization (WHO) classifies as a high annual incidence rate for T1DM, which is anything above 20 per 100,000 (Patterson *et al.*, 2009).

The term 'standardized incidence' refers to a calculation of the actual incidence with the expected incidence from similar populations in other locations (Wojcik *et al.*, 2015). For example, if 30 per 100,000 is the usual (expected) incidence, but a country has an incidence of 60 per 100,000, then it has a standardized incidence rate of 2.0 (double the expected incidence). The KSA has a reported T1DM prevalence rate five times the WHO high incidence rating for young people, therefore reducing the cost of managing T1DM among schoolchildren has the potential to contribute to long-term government savings. In most developed countries there are specific policies and specialist organisations that focus on the effective management of T1DM in children (e.g., American Diabetes Association (ADA), Diabetes UK).

However, there is no such policy or organisational provision in the KSA. This does not mean that there is a total absence of state provision. For instance, there are some diabetes centres that belong to public hospitals. There are also school health

units located outside school premises which are responsible for providing annual student general health checks, immunisation administration, health advice and general supervision of school hygiene. Despite these provisions there are still substantive improvements to be made, since diabetes centres and other health units are not coordinated at a national level, which may often leave gaps in the provision of effective diabetes health services.

## **GLOBAL EPIDEMIOLOGY OF CHILDHOOD DIABETES**

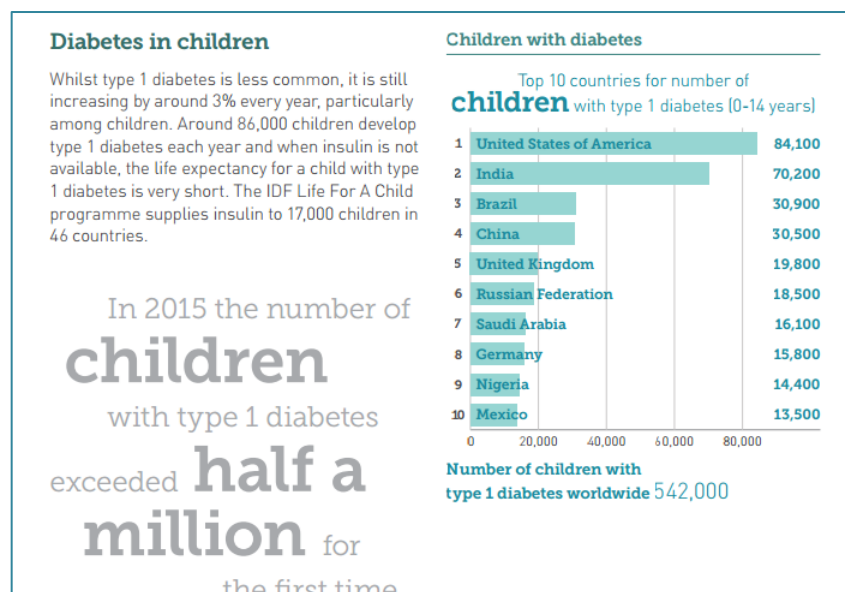
T1DM is an endocrine disorder characterised by the absolute deficiency of insulin caused by the autoimmune destruction of the  $\beta$  cells of the pancreas. As the  $\beta$  cells are destroyed, the secretion of insulin starts to decrease, and, due to a lack of insulin, the body fails to maintain normal blood glucose levels effectively. When most of the  $\beta$  cells are destroyed (i.e., 80-90%) the condition of 'hyperglycaemia' (high blood glucose levels) develops, and a diagnosis of diabetes is established. Although diabetes is a lifelong condition, T1DM occurs where the pancreas does not produce *any* insulin, and T2DM occurs where the pancreas does not produce *enough* insulin (or the body does not react to insulin that is produced). Consequently, children diagnosed with T2DM may sometimes be able to control diabetes symptoms through diet, exercise, and lifestyle changes. On the other hand, once children are diagnosed with T1DM, they normally have to take insulin injections throughout their lifetime in order to maintain their blood glucose levels within prescribed limits (American Diabetes Association, 2009).

The term 'epidemiology' is generally referred to as the study of the causes, effects, and patterns of health and disease conditions within specific defined populations. Both prevalence and incidence have been used as measures of the disease. In terms of epidemiological research, where primary prevention or secondary intervention is required to be a major outcome, reporting of the incidence of the disease is believed to be a more efficient and useful measure (Soltesz *et al.*, 2007). In practice, T1DM typically accounts for 5-10% of the total cases of those with diabetes (American Diabetes Association, 2009). Although the annual increase in incidence is relatively high in both North America and Europe, the yearly increase of 4% in Asian countries has been noted to be of particular concern (DIAMOND Project Group, 2006). Although it affects all age groups, T1DM has been, and continues to be, the most common type of diabetes in children, and accounts for  $\geq 85\%$  of all diabetes cases in

young people aged less than 20 years of age worldwide (Liese *et al.*, 2006; Dabelea *et al.*, 2007).

The only chronic childhood disorder that is more prevalent than T1DM is asthma, and, according to Holt (2004), approximately twenty million people (mostly children and young adults) have T1DM worldwide. According to the International Diabetes Federation (IDF), in 2011 the global prevalence of T1DM for age groups under 15 years of age was approximately 23 per 100,000 (IDF, 2011). Previous estimates by the IDF showed that the number of children (under 15 years) with T1DM was approximately 497,100 (26% in Europe, 22% in the North America and Caribbean Region), and that some 79,100 children (under 15 years) are estimated to develop T1DM annually worldwide (IDF, 2013). More recent 2015 estimates show that the number of children with T1DM is approximately 542,000, with around 86,000 children developing T1DM each year (IDF, 2015) (Figure 1).

**Figure 1: Diabetes in Children (IDF, 2015, p.16)**



It has also been acknowledged that the number of children with diabetes attending primary school has increased, and is expected to increase further in the near future (Hill *et al.*, 2007; American Diabetes Association, 2012). The rising incidence of T1DM has also been reported consistently worldwide, with the average incidence increasing by 3% annually (IDF, 2011). The increased incidence worldwide is particularly marked in young children (DIAMOND Project Group, 2006). For instance, in 2011 approximately 78,000 children throughout the world were estimated to

develop T1DM annually (IDF, 2011). By 2013, this number had risen to more than 79,000 children developing T1DM annually (IDF, 2013).

The enormity and seriousness of this life-threatening disease has prompted the establishment of international, national and regional childhood diabetes registry institutions. These institutions aim to establish a network for the prospective registration of newly diagnosed children with T1DM in different countries around the world, using a standardised protocol for data collection. The most renowned international T1DM childhood registries are the EURODIAB (The Epidemiology and Prevention of Diabetes) and 'DIAMOND' (the World Health Organization Multinational Project for Childhood Diabetes) networks. The EURODIAB registry includes approximately 30 million children located within most of Europe, and with nearly 44 European centres contributing to the registry. The DIAMOND network includes 112 centres from 57 countries around the world, which represent approximately eighty four million children worldwide (Soltesz *et al.*, 2007).

According to this registry, 43,000 children were diagnosed with T1DM between the years 1990 and 1999 (DIAMOND Project Group, 2006). For data collected by the EURODIAB ACE study during the period 1990 to 1994, there was an annual increase in the incidence rate of T1DM of 3.4% (95% Confidence Interval (CI) 2.5-4.4%) (EURODIAB ACE Study Group, 2000). The rates of increase were identified as highest in the younger age brackets (0-4 years (6.3%, 95% CI 5-8.5%); 5-9 years (3.1%, 95% CI, 1.5-4.8%); and 10-14 years (2.4%, 95% CI, 1.0-3.8%) (EURODIAB ACE Study Group, 2000). It is envisaged that epidemiological research and data collection of this magnitude will deliver a better understanding and identification of the causal factors of T1DM and its complications. It may also elucidate the complex nature of the interaction between genetic and environmental factors that precipitate this disease. There can be no doubt that the wealth of information acquired will aid in the better management, treatment, prevention, and perhaps eventually cure of T1DM.

Karvonen *et al.* (2000) analysed the data for T1DM from 1990 to 1994 in children (14 years or under) from 100 participating incidence data centres located in 50 countries. The analysis revealed a wide global variation in the incidence, prevalence, and temporal trends in T1DM (Karvonen *et al.*, 2000). A total of 19,164 cases were

diagnosed in study populations totalling 75.1 million children, which revealed a greater than 350-fold variation in the incidence of T1DM among the 50 countries studied worldwide (Karvonen *et al.*, 2000). The overall age-adjusted incidence was found to vary from 0.1 per 100,000 (per year) in China and Venezuela, to 36.5 per 100,000 (per year) in Finland and 36.8 per 100,000 (per year) in Sardinia (Karvonen *et al.*, 2000). Age adjustment was carried out in 5-year intervals (0-4, 5-9, 10-14 years) using the direct method with a standard population made up of equal numbers of children in each of the three year sub-groups (Karvonen *et al.*, 2000). Wide variations in the incidence of insulin-dependent diabetes were reported long ago, even within small geographically-defined populations (Karvonen *et al.*, 2000). A marked variation in the incidence from 6.0 per 100,000 to 36.9 per 100,000 was reported among five different populations around the Baltic Sea (Tuomitetho *et al.*, 1992).

The incidence of T1DM was also found to increase with age for most of the populations investigated (higher incidences in people over 40-50 years of age who later develop T1DM) (EURODIAB ACE Study Group, 2000; Karvonen *et al.*, 2000). The increase in the rate of incidence worldwide is particularly marked in young children (DIAMOND Project Group, 2006), with European registries indicating that the highest T1DM incident rates were observed for the 10-14 years old age group (EURODIAB ACE Study Group, 2000; Karvonen *et al.*, 2000). This would seem to indicate that T1DM is present at high incidence levels for certain ranges of age groups (young children and people over 40-50 years of age). The SEARCH for Diabetes in Youth study in the USA aimed to identify cases of diabetes (incidence and prevalence) in individuals aged 20 years or less (Liese *et al.*, 2006; Maahs *et al.*, 2010). From 2002 to 2003, 1,905 youths with T1DM were diagnosed in the SEARCH study from a population of more than 10 million under surveillance (Liese *et al.*, 2006; Maahs *et al.*, 2010). It was found that the prevalence of T1DM was 2.28/1000 in youths aged less than 20 years old (5,399 cases in a population of 3.5 million) (Liese *et al.*, 2006; Maahs *et al.*, 2010).

Diaz-Valencia Bougnères and Valleron (2015) carried out a systematic review of the literature on global epidemiology of T1DM in young adults and adults (70 articles published between 1982 and 2004). They studied variations of incidence of T1DM in adults with country and age for geographically defined populations in thirty five

countries (Diaz-Valencia Bougnères and Valleron, 2015). It was found that there was a significant geographical correlation (Spearman correlation coefficient) between adult T1DM incidence, and children (0-14 years) incidence in the age classes 15-19 years, 20-24 years, 30-34 years, and overall (15-60 years). Diaz-Valencia Bougnères and Valleron (2015) argued that the strong geographical correlation of incidences in adult and children could be explained because of adults with T1DM sharing the gene alleles known to be associated to incidence of T1DM in children, as well as predisposing environmental causes.

Diabetes UK compiled a list of countries by incidence of T1DM in children aged 0 to 14 years, based on data provided by the IDF in 2011 (Diabetes UK, 2016a). The high incidence of T1DM children in the Scandinavian countries such as Finland, Sweden and Norway, has been ascribed by many as arising because of a unique combination of genetic and environmental factors. For example, it has been noted that:

...some researchers suspect there may be a connection between Finland's cleanliness and the incidence of the disease there. They are investigating whether the lack of exposure to a specific group of bacteria found in the intestine may be causing weaker immune systems in Finnish children, making them more susceptible to Type 1 diabetes (Niiler, 2014).

Harjutsalo *et al.* (2013) believed there were a number of potential causalities relating to the high prevalence of T1DM in children in Finland. They proposed that these included the increased prevalence of overweight and obesity, and a 10-fold increase in severe enterovirus infections in Finland from 2006 to 2010 (Harjutsalo *et al.*, 2013). However, they also believed that the fortification of dairy products with Vitamin D after 2003 may have contributed to the levelling off of T1DM incidence in Finland (Harjutsalo *et al.*, 2013).

**Table 1: List of countries by incidence of T1DM ages 0 – 14 (Diabetes UK, 2016a)**

Position	Country	Incidence (per 100,000)
1	Finland	57.6
2	Sweden	43.1
3	Saudi Arabia	31.4
4	Norway	27.9



Position	Country	Incidence (per 100,000)
5	United Kingdom	24.5
6	USA	23.7
7	Australia	22.5
8	Kuwait	22.3
9	Denmark	22.2
10	Canada	21.7
11	Netherlands	18.6
12	Germany	18
12	New Zealand	18
14	Poland	17.3
15	Czech Republic	17.2
16	Estonia	17.1
17	Puerto Rico	16.8
18	Ireland	16.3
18	Montenegro	16.3
20	Malta	15.6
21	Luxembourg	15.5
22	Belgium	15.4
23	Cyprus	14.9
24	Iceland	14.7
25	Slovakia	13.6
26	Austria	13.3
27	Portugal	13.2
28	Spain	13
29	Serbia	12.9
30	United States Virgin Islands	12.8
31	France	12.2
32	Italy	12.1
32	Russian Federation	12.1
34	Qatar	11.4
35	Hungary	11.3
36	Slovenia	11.1
37	Israel	10.4
37	Greece	10.4
39	Bahamas	10.1

Position	Country	Incidence (per 100,000)
39	Sudan	10.1
41	Bulgaria	9.4
42	Switzerland	9.2
43	Croatia	9.1
44	Libyan Arab Jamahiriya	9
45	Algeria	8.6
46	Uruguay	8.3
47	Ukraine	8.1
48	Egypt	8
49	Lithuania	7.8
50	Brazil	7.7
51	Latvia	7.5
52	Tunisia	7.3
53	Argentina	6.8
54	Chile	6.6
55	Dominica	5.7
56	Belarus	5.6
57	Romania	5.4
58	Georgia	4.6
59	India	4.2
60	Macedonia	3.9
61	Taiwan	3.8
62	Iran	3.7
63	Antigua and Barbuda	3.5
63	Bosnia and Herzegovina	3.5
65	Jordan	3.2
66	Nigeria	2.9
67	Oman	2.5
67	Singapore	2.5
69	Japan	2.4
70	Cuba	2.3
71	Barbados	2
71	China, Hong Kong SAR	2
73	Mexico	1.5
74	Mauritius	1.4

Position	Country	Incidence (per 100,000)
75	Colombia	1.3
76	Uzbekistan	1.2
76	Tajikistan	1.2
78	Republic of Korea	1.1
79	United Republic of Tanzania	0.9
79	Paraguay	0.9
81	Zambia	0.8
82	China	0.6
83	Dominican Republic	0.5
83	Pakistan	0.5
83	Peru	0.5
86	Ethiopia	0.3
86	Thailand	0.3
88	Papua New Guinea	0.1
88	Venezuela	0.1

## THE EPIDEMIOLOGY OF DIABETES IN GULF COOPERATION COUNTRIES

There are six Gulf Cooperation Countries (GCC), these are Bahrain, Kuwait, Oman, Qatar, the KSA and the United Arab Emirates (UAE). Very little information is available on epidemiology of T1DM in these countries. The incidence of T1DM in GCC was at a low level in Oman (5 per 100,000), high in Bahrain (19.99 per 100,000) and the KSA (10 per 100,000), and very high (>20 per 100,000) for Kuwait and Qatar, as classified by the DIAMOND study (DIAMOND Project Group, 2006). During this period data was not available for the UAE (Abdullah, 2005). In a recent review article about prevalence studies of diabetes, five of the 6 countries with the world's highest national prevalence were identified as being in the Middle-East (Shaw *et al.*, 2010). Satisfactory epidemiological studies on the incidence and prevalence of diabetes are lacking for GCC, however some studies have reported the incidence of T1DM.

### The Epidemiology of Diabetes in Bahrain

Impaired glucose tolerance (IGT) is widely recognised as a stage preceding the onset of diabetes, when blood glucose levels are seen to be elevated above normal levels. The prevalence of IGT for individuals of between 20-79 years in Bahrain was

estimated at 16.3% for 2013, rising to an estimated 16.7% by 2035 (IDF, 2013). Other estimated figures provided by the IDF (2013) included 974,960 people (20-79) with diabetes, and a national prevalence level of 17.30%. The IDF provided an estimated diabetes comparative prevalence (WHO standard) of 22.40% (IDF, 2012). Another study indicated comparative diabetes prevalence (adjusted to the world population) for Bahrain for T2DM at 19.8% (Badran and Laher, 2012).

Al-Mahroos and McKeigue (1998) undertook a random sample of 2000 Bahraini native men aged 40-59 years, and 2000 Bahraini native women aged 50-69 years. It was found that the total prevalence of men was 26% compared to a total prevalence for women of 36% (Al-Mahroos and McKeigue, 1998). Prevalence statistics for children in Bahrain are difficult to identify. For children in Bahrain, the estimated levels of diabetes are higher, with a recent study (on children (6-13 years) in 20 schools across Bahrain) conducted by the Al Kindi Specialised Hospital (supported by the Education and Health Ministries) citing more than 30% of Bahrain's children being at risk of developing T2DM owing to poor diet and exercise (Trade Arabia, 2012). A more recent study showed that the number of children diagnosed with T1DM in Bahrain had risen significantly, with 25 new cases of paediatric T1DM diagnosed per 100,000 population in 2010 (Trade Arabia, 2012).

It has been argued that rates of T1DM have more than doubled in the past decade (Hart *et al.*, 2013). Indeed, countries with the highest diabetes prevalence rates in the world include Bahrain and other Gulf State countries (IDF, 2013). Al-Mahroos and McKeigue (1998) conducted a cross-sectional study of 2,128 Bahrainis (40-69 years). It was concluded that the high rates of diabetes in Bahrain appeared to be derived from part of a familial syndrome that included raised plasma cholesterol levels, with risk related to ethnic origin and obesity levels (Al-Mahroos and McKeigue, 1998). In theory, this might mean that children in Bahrain demonstrate higher prevalence levels of diabetes owing to a combination of poor diet and exercise, together with a genetic predisposition to the development of diabetes.

Added to this, one study on the knowledge of diabetes among 1,064 Bahraini school teachers showed that the Bahraini teachers were deficient in knowledge of diabetes (Alnasir, 2003). Another study conducted in Bahrain on the knowledge of schoolteachers about health topics showed that they had only average knowledge

about diabetes (Alnasir and Skerman, 2004). Teachers with personal experience of illness were observed to have more knowledge about diabetes (Alnasir and Skerman, 2004). Given the high incidence rates of diabetes in children in Bahrain, there would seem to be a strong case for the need to educate schoolteachers about health topics such as T1DM.

### **The Epidemiology of Diabetes in Kuwait**

The first report from Kuwait about T1DM in children (14 years or less) found an incidence rate of 3.96 per 100,000 from 1980 to 1981 (Taha *et al.*, 1983). Another prospective study of T1DM in children (14 years or less) in Kuwait, found that over a period of 6 years (1992-1997) the incidence rate had increased to 20.1 per 100,000 (95% CI, 18.0-22.1), with a slightly higher age-standardized incidence rate of 20.9 per 100,000 (95% CI, 18.8-23.0) (Shaltout *et al.*, 2002). In the same study, a peak was also observed in the 5-9 years age category (Shaltout *et al.*, 2002). This report showed one of the highest incidence rates for T1DM in children reported in GCC. Moussa *et al.* (2005) determined the prevalence of T1DM among the population of 349 (132 males, 217 females) Kuwaiti school children (aged 6 to 18 years of age) from 182 schools (50 primary schools, 63 intermediate schools, 69 secondary schools) in the 5 governorates of Kuwait.

The longitudinal study took place from October 2000 to September 2002, and a very high prevalence of 269.9 per 100,000 was observed, with almost the same distribution in males and females (Moussa *et al.*, 2005). T1DM was observed to be more prevalent (237.3 per 100,000) in the age group of 10-13 years, and lowest (182.6 per 100,000) in the age group of 6-9 years (Moussa *et al.*, 2005). The mean age of onset was found to be 9.2 years for males and 8.1 years for females (Moussa *et al.*, 2005). The IDF provided an estimated diabetes comparative prevalence (WHO standard) of 23.86% (IDF, 2012).

A recent study conducted in Kuwait showed an increase in the frequency of 'diabetic ketoacidosis' (DKA) and high prevalence of T1DM in children less than 12 years of age (Abdul-Rasoul *et al.*, 2010). DKA is a condition where an individual with either T1DM or T2DM exhibits consistently high blood glucose levels (Diabetes UK, 2016b). This can lead to a severe lack of insulin in the body, and since the body cannot use glucose for energy, it starts to break down other body tissue as an energy source

(Diabetes UK, 2016b). Ketones are produced as a by-product of this process, and the build-up of these poisonous chemicals in the body leads to the body becoming acidic and the individual is left in a life-threatening condition (Diabetes UK, 2016b).

### **The Epidemiology of Diabetes in Oman**

In Oman, the incidence of T1DM for children <14 years was found to be 2.45-2.62 per 100,000 (Soliman *et al.*, 1996). This reported rate was one of the lowest of the GCC (Soliman *et al.*, 1996). According to another study conducted by the National Centre for Diabetes, Endocrine and Genetics Diseases, the incidence of T1DM in the under 14 year age group was found to be 2.8-3.6 per 100,000 between 1992-1996 (Ajlouni *et al.*, 1999). This reported incidence rate was similar to neighbouring countries, and one of the lowest in this region (Ajlouni *et al.*, 1999). A recent retrospective analysis conducted on children with T1DM at Sultan Qaboos University Hospital, Oman (from June 2006 to May 2013) reported the clinical presentation of the disease (Al-Yaarubi *et al.*, 2014). The mean age of diagnosis was found to be  $6.7 \pm 3.7$  years for 144 patients (Al-Yaarubi *et al.*, 2014). DKA was found to be 31% among the patients diagnosed with T1DM, which was less common compared to other diabetes centres in the Middle East (Al-Yaarubi *et al.*, 2014). Family history of T1DM was found to be a major factor among these children (Al-Yaarubi *et al.*, 2014). The IDF provided an estimated diabetes comparative prevalence (WHO standard) of 10.16% (IDF, 2012).

### **The Epidemiology of Diabetes in Qatar**

A study reported a prevalence of 16.7% for diabetes in the adult Qatari population (Bener *et al.*, 2009). The diabetes proportion was found to be slightly higher in females (53.2%) compared to males (46.8%) (Bener *et al.*, 2009). The study acknowledged that obesity was found to be associated with diabetes in the adult Qatari population (Bener *et al.*, 2009). It was also reported a high percentage of pre-diabetes that was expected to increase the prevalence of diabetes in the next few years (Bener *et al.*, 2009). A presentation at the Pan Arab conference in Riyadh noted that the incidence in Qatar was said to have increased to 22.2 per 100,000 in 2003 (Al-Ali *et al.*, 2004). There would seem to be a larger probability that similar increases will be reported from other Gulf countries in the near future. The IDF provided an estimated diabetes comparative prevalence (WHO standard) of 23.33% (IDF, 2012). Another study conducted from 2006 to 2011 into the incidence of T1DM

in children of <14 years (n=385) showed a slight increase in incidence of 23.11 per 100,000 (Soliman *et al.*, 2012).

### **The Epidemiology of Diabetes in the UAE**

A study conducted in Al-Ain hospital in the UAE from 1990 to 1998 on adults over 18 years old found that the age at diagnosis was  $9.2 \pm 4.1$  years (Punnose *et al.*, 2002). The study reported a very high number of patients experiencing DKA, with much higher rates than observed more generally (Punnose *et al.*, 2002). El-Sharkawy (2004) noted that two other studies reported that the prevalence of diabetes among UAE citizens was the second highest in the entire world (El-Sharkawy, 2004). The first study conducted on the urban adult population over 30 years old in Al Ain, UAE showed a prevalence rate of over 20%, and 25.4% in urban areas and 14.1% in rural areas (El-Sharkawy, 2004). The second study conducted jointly by the UAE Ministry of Health and the WHO from 1998 to 2000 on a sample of 6,609, showed that 19.6% of people were diagnosed with diabetes (El-Sharkawy, 2004).

Another subsequent study confirmed the high prevalence of diabetes in the UAE (Saadi *et al.*, 2007). The Department of Health and Medical Services reported 304 children (4-19 years) with diabetes in Dubai in 2005, and among these children, T1DM accounted for 91.2% of Emirates diabetic cases (Department of Health and Medical Services, 2006). The distribution of children based on education level was observed to be 7.4% in kindergarten, 41.0% in primary school, 21.0% in intermediate school, and 30.6% in secondary school (Department of Health and Medical Services, 2006). The IDF provided an estimated diabetes comparative prevalence (WHO standard) of 18.87% (IDF, 2012).

### **The Epidemiology of Diabetes in the KSA**

The KSA has witnessed rapid cultural and social changes in the last three decades since the discovery of oil, and the attendant economic benefits that it has brought. This has impacted considerably on many aspects of the general lifestyle of the Saudi population, including increased urbanisation, profound changes in dietary habits, and what has been referred to as an increasingly sedentary lifestyle (Mahfouz *et al.*, 2007; Amin *et al.*, 2008). These changes have been accompanied by an increase in the rates of obesity and other chronic non-communicable diseases such as

hypertension, coronary heart disease and stroke (Thompson *et al.*, 1999; Alsaif *et al.*, 2002).

Previous studies have also indicated that diabetes is present in epidemic proportions in the KSA, thereby constituting a major public health problem (Al-Shammari *et al.*, 1994; Kordy *et al.*, 1995; Al-Nuaim *et al.*, 1996; Al-Nuaim *et al.*, 1997; Alzaid, 1997). In Al-Madina, the largest city in the North West of the KSA, for the period 2004-2009 the average incidence rate was found to be 29.0 per 100,000, the highest in the Middle East and North Africa (MENA) Region (Habeb *et al.*, 2011). It was found there had been no statistically significant change in the annual incidence rate during the 6 year period (Habeb *et al.*, 2011). The IDF provided an estimated diabetes comparative prevalence (WHO standard) of 23.38% (IDF, 2012).

A recent Saudi community-based investigation showed that the prevalence of T1DM for children below the age of 19 years was 109 per 100,000 (Alherbish *et al.*, 2008). The IDF (2013) noted that the KSA had 14,900 children with T1DM which equated to approximately a quarter of the MENA Region's total of 64,000. In 2013 there were 64,000 children (0-14 years) with T1DM and the number of newly diagnosed cases per year was estimated at 10,700 per year (IDF, 2013). Another study conducted by Abduljabbar *et al.* (2010) into the incidence trends of 438 children (less than 15 years) with T1DM in the east of the KSA during 1990-2007, reported an *average* incidence rate of 27.52 per 100,000 (for children receiving medical care at the Saudi Aramco Medical Services Organization, Dhahran Health Centre).

The incidence rate increased from 18.05 per 100,000 in the first 9 years of the study period, to 36.99 per 100,000 in the last 9 years, thereby representing a very significant increase over the 18 year period investigated (Abduljabbar *et al.*, 2010). The doubling of the childhood T1DM incidence rate from 1998 to 2007 demonstrated what Abduljabbar *et al.* (2010) labelled as an 'alarming' increase which required the implementation of a national diabetes registry to study the epidemiology in the KSA. Habeb *et al.* (2011) also drew attention to the limited data available on the incidence rate of childhood T1DM in the KSA. On the whole it would seem to be the case that the incidence of T1DM in childhood is increasing, although the precise rates cannot be clearly identified. Current evidence is less than concrete, and central statistics are so poor in the KSA, that no other definitive conclusion can be drawn at this time.



The presence of reliable registries of diabetes (and incidence rates) is of paramount importance in such cases. The IDF reported that the MENA region had the highest comparative prevalence of diabetes (11%) in adults, with 356,586 reported deaths in the MENA Region in 2012 (IDF, 2012). Another cause for concern, is that the prevalence for the younger age groups in the MENA region is substantially higher than the global average (64.9 per 100,000 for T1DM in 0-14 years children), with the largest contribution of children with T1DM coming from the KSA (IDF, 2012). According to Elhadd *et al.* (2007), diabetes is well-studied in the KSA, however what is lacking is research in the area of education and health care delivery concerning diabetes in general, and especially involving children. Education programmes on diabetes and its management are of paramount importance in order to lessen chronic diabetes complications, and in order to help to reduce the expected morbidity and mortality rates from diabetes in the future.

## **FACTORS CONTRIBUTING TO T1DM**

The huge increase in incidence of T1DM cannot be interpreted simply by genetic factors, since the gene pool would very likely have not changed so significantly within such a short time frame. The results obtained would seem to suggest an increased influence of environmental factors in the development of T1DM during the last two decades. Indeed, the role of environmental factors has been highlighted by other studies in this area (Hermann *et al.*, 2003; Gillespie *et al.*, 2004). It is therefore reasonable to assume that countries that have experienced rapid socioeconomic changes might be good candidates for the testing and development of the impact of specific genetic and environmental factors, as well as their interaction on the pathogenesis of T1DM. The GCC differs in its socioeconomic position and these differences are related with change in lifestyle and eating practice. Food habits and lifestyle vary considerably from urban to nomadic and semi-nomadic populations. All of these environmental factors and their interaction with genetic factors predispose the individuals to T1DM (Shaw *et al.*, 2010).

Data from large epidemiological studies of 43,013 cases in study populations of 84 million children examined trends in incidence of T1DM, revealing statistically significant increases across the world (5.3% in North America, 4% in Asia, and 3.2% in Europe) (DIAMOND Project Group, 2006). The studies showed that these

increases could not be attributed to genetic shift, and the studies therefore concluded that environmental causative factors, or gene-environmental interactions, had to be investigated further (DIAMOND Project Group, 2006). Recent studies have also suggested an increased influence of environmental factors in the development of T1DM, and its stronger effect on individuals with lower risk genotype as compared to those at higher risk genetically (Pociot and McDermott, 2002; Adeghate *et al.*, 2006; Ghazarian *et al.*, 2013). Genetic studies discovered more than 20 diverse chromosomal regions associated with T1DM (Pociot and McDermott, 2002). Numerous genes are found to be responsible for more than 40% of the familial T1DM (Pociot and McDermott, 2002). Other studies have demonstrated that different ethnic groups with different genetic makeup show varied susceptibility to T1DM (Pociot and McDermott, 2002).

Some environmental factors were reported to be important in influencing the rate of progression of the disease (Gale, 2002). However, many environmental factors were suggested to be contributing to the increased incidence of T1DM including viral infections, physical inactivity, excessive hygiene, and excessive food intake (Gale, 2002; Adeghate *et al.*, 2006; Ghazarian *et al.*, 2013). Many theories were presented as factors that increase T1DM and six of them (i.e., hygiene, viral, vitamin D deficiency, breast milk and cow's milk hypotheses) were reviewed (Eggo, 2013). Among the entire postulated theories the 'hygiene hypothesis' would seem to emerge as one of the most widely accepted theories. The hygiene hypothesis proposes that being exposed to a large number of infective agents, such as measles, chickenpox, parasites or symbiotic microorganisms in early childhood allows children to successfully develop a strong autoimmune defence system. The hygiene hypothesis asserts that if a strong autoimmune defence system is not developed early on (because of excessive hygiene during childhood), this might leave an underdeveloped (and potentially harmful) autoimmune system in adulthood (Gale, 2002).

From a biological perspective, a child's developing immune system must receive external stimuli from bacteria, parasites, and infectious agents in order to develop sufficient levels of regulatory T cells in the body. If a human body has an effective immune system in place, the body's immune system will produce a sufficient T cell response to host immunity effectors. The body will produce a TH1-mediated immune

response to intracellular bacteria and protozoa, which will also down-regulate TH2-mediated immune responses to extracellular parasites. But Bach and Chatenoud (2012, p.4) argue that "the reverse trend observed between infectious disease incidence and the incidence of autoimmune and allergic diseases" provides remarkable epidemiological evidence in support of the hygiene hypothesis. In essence they consider that there is a negative correlation between children's hygienic conditions and the incidence of T1DM, which in turn is likely moderated by other external factors (Bach and Chatenoud, 2012).

However, Okada *et al.* (2010) propose that epidemiological data (particularly migration studies) which show a correlation between high disease incidence and high socio-economic level are not sufficient to prove conclusively a causal link between infections and human disorders. Further proof has been provided by animal models and intervention trials in humans, but the hygiene hypothesis is not beyond question (Okada *et al.*, 2010). Okada *et al.* (2010) consider that underlying mechanisms may in actuality be multiple and complex, and may include decreased consumption of homeostatic factors and immunoregulation of T cell subsets and Toll-like receptor stimulation. In the absence of definitive proof, other theories have been proposed to explain the onset of diabetes. The 'Barker Hypothesis' is a theory proposed by the British epidemiologist David Barker, that low birth weight in infants had a causal relationship to the origins of non-insulin dependent diabetes (Barker *et al.*, 1989). Dover (2009, p.201) explains that:

It appears that adaptations to prenatal and postnatal environments establishes patterns of interaction between genes which control a variety of cellular and organ functions, which allows individuals to survive early prenatal and postnatal life but which have adverse consequences much later.

The viral hypothesis is based on the notion that viruses such as cytomegalovirus (CMV), enterovirus, mumps virus, rotavirus and rubella virus might induce and speed up the autoimmune response in T1DM, although the mechanism of this process is unknown (Eggo, 2013). Some epidemiological studies reported deficiency of Vitamin D in T1DM (Eggo, 2013). Countries which receive enough sunlight showed similar incidence to countries at extreme latitudes, and countries within similar latitudes

showed varied incidence (Egrol, 2013). The association of cow's milk formula (rather than breastfeeding) with the autoimmune response is suggested based on molecular mimicry as well as deficiency of some cytokines and growth factors (Egrol, 2013). Although many theories are suggested, the issue of environmental-gene interaction and its relationship with T1DM incidence or progression is far from being resolved. In short, what can be said is that T1DM is a complex endocrine disorder caused by genetic factors that can in practice be modified by environmental factors, and which could play the role of triggering accelerating, delaying, or even preventing the development of T1DM.

## **PATHOPHYSIOLOGY OF T1DM**

A brief pathophysiology of T1DM is presented here in order to provide an overview of the onset, development, diagnosis, and current medical treatment of T1DM.

### **Signs and Symptoms of T1DM**

What have been generally referred to as the classic symptoms of T1DM are polyuria (excessive urination), polydipsia (excessive thirst), polyphagia (excessive hunger), glycosuria (high levels of glucose in the urine), and unexplained weight loss (NHS Choices, 2015; American Diabetes Association, 2016). Other signs of the onset of T1DM include general feelings of tiredness or fatigue, blurred vision, continuing nausea, weight loss or loss of muscle tissue, and itchiness around the genital areas (NHS Choices, 2015). The symptoms of T1DM in children can develop relatively quickly over a period of a few days or weeks, whereas symptoms in older adults normally appear over a longer time span of a few months.

### **Diagnosis of T1DM**

There is now a well-established test used for the medical diagnosis of diabetes. The test is based on blood glucose criteria which include either a fasting plasma glucose (FPG) level of  $\geq 7.0$  mmol/L, or a 2-hour plasma glucose level of  $\geq 11.1$  mmol/L (this is taken during a 75g oral glucose tolerance test (OGTT) which uses a glucose load containing the equivalent of 75g anhydrous glucose dissolved in water) (American Diabetes Association, 2009). The OGTT is not routinely used to diagnose either T1DM or T2DM owing to the fact that individuals normally need to be present at a clinic or hospital at the zero time (baseline) drawing of a blood sample, and again

present for the drawing of blood (for measuring blood sugar levels) at a 2 hour interval (Gerstein, 2001). Another test which may be administered on individuals presenting classic symptoms of hyperglycaemia is the 'random plasma glucose test' (RPGT). This test is performed in emergency medical rooms or when doctors do not want to wait for a FPG test to be administered, and consists of the taking and measuring of plasma glucose levels  $\geq 200$  mg/dl (11.1 mmol/L).

The glycosylated haemoglobin (HbA1c) test has also been recommended recently by the ADA as a biomarker for glycaemic control, although this test is not specifically used in the primary diagnosis of T1DM (American Diabetes Association, 2008). Excess glucose present in the blood binds to the haemoglobin present in the red blood cells to form glycosylated haemoglobin (Larsen *et al.*, 1990). Red blood cells circulate in the body and live for about three months before they are replaced. For this reason the HbA1c test is considered by some (e.g. Thomas and Elliot, 2009) to be the best measure of long-term glycaemic control, as it represents the average blood glucose levels in an individual over several months. The HbA1c test has been introduced recently as additional or secondary diagnostic criteria for diabetes and pre-diabetes (Veeranna *et al.*, 2011; Janghorbani and Amini, 2012).

### **Treatment of T1DM**

At present there is no cure for T1DM and therefore the treatment of T1DM centres on providing insulin therapy, consistently monitoring blood glucose levels, and identifying and correctly addressing potential health problems that may be occurring or developing. It is also generally recommended that individuals develop a comprehensive diet and exercise plan that addresses calorific intake; daily carbohydrate, fat, and protein intake; the timing of meals; and sufficiently regular exercise (American Association of Diabetes Educators, 2016; Diehl, 2016). This is because complications such as long-term hyperglycaemia can often lead to vascular and microvascular complications such as retinopathy and neuropathy, or alternatively DKA. Individuals that have been diagnosed with T1DM invariably require lifelong insulin therapy because of their inability to produce sufficient insulin in the body.

There are however, a range of different insulin therapies available which can differ in their effect and may be used by individuals with different levels of insulin deficiency. For instance, some last for an entire day (long-acting), some for up to eight hour

periods (short-acting), and some are used for quick response times (rapid-acting) (ADA, 2009; ADA, 2011b). There are two well established forms of taking insulin on a daily basis, namely insulin injections and insulin pumps. Insulin injections can normally be given via insulin injection pens or auto-injectors, or sometimes via sterile disposable needles. Alternatively, an insulin pump consists of a small device that contains insulin and which is attached to a needle inserted into the individual's stomach, arms, or thighs (ADA, 2009; ADA, 2011b). The insulin pump provides a continuous flow of insulin into the bloodstream at a controlled rate, and is therefore often an effective form of injecting insulin for younger children (NHS Choices, 2015).

The long-term treatment of T1DM typically involves establishing glycaemic goals which maintain normal levels of glucose in the body throughout each day. ADA guidelines recommend using the individual's age as one factor in the establishment of such goals, with different targets set for pre-prandial, bedtime, and HbA1C levels in patients aged 0-6 years, 6-12 years, and 13-19 years (American Diabetes Association, 2011a; 2011b). It has been observed that the benefits of tight glycaemic control "include not only continued reductions in the rates of microvascular complications but also significant differences in cardiovascular events and overall mortality" (Medscape, 2015). Best practice guidelines put forward by the British Medical Journal (BMJ) centre on tailoring the aggressiveness of T1DM insulin therapy to the individual, with target recommendations of HbA1c, namely <59 mmol/mol (<7.5%) (<18 years) and <53 mmol/mol (<7%) (>18 years), and less stringent goals applied to very young children (BMJ, 2014).

### **Complications with T1DM**

Diabetes is a serious disease that has both acute and chronic complications. Acute complications include hypoglycaemia (low blood glucose) and hyperglycaemia (high blood glucose), both experienced as the body struggles to balance insulin, food, and physical activity. Chronic complications include blindness, nerve damage, cardiovascular and kidney disease. For children with T1DM, the ability to monitor blood glucose regularly, as well as balancing insulin, foods, and activity, are essential in preventing or minimising potential future health complications (American Diabetes Association, 2003). Severe hypoglycaemia is a well-known complication of diabetes in children. In the event that a child with T1DM experiences hypoglycaemia, it can usually be treated effectively and with ease. If hypoglycaemia is not recognised, and

consequently leads to a severe hypoglycaemic state, a glucagon injection may become necessary. Glucagon administration is the treatment of choice for those hypoglycaemic episodes leading to a loss of consciousness (American Diabetes Association, 2003).

Hershey *et al.* (2004) point out that severe hypoglycaemia occurs more often during childhood than adulthood and has been linked with cognitive dysfunction and poor academic performance in children. In contrast, hyperglycaemia is a condition in which excessive amounts of glucose and insufficient insulin circulate within the blood (American Diabetes Association, 2006). In order to reduce hyperglycaemic symptoms, additional insulin doses may be necessary during the school day. Because of the potential daily needs of children with diabetes, teachers and other school personnel need to be aware of the symptoms and treatment of hyperglycaemia, as well as being able to provide support if additional insulin is required.

Hyperglycaemia and insufficient insulin can lead to DKA, which is the most common clinical sign found in young children with T1DM (American Diabetes Association, 2012). DKA is observed in approximately 67.2% of patients (Salman *et al.*, 1991). Insulin is the key that unlocks the body's cells in order to allow glucose to enter the cells to provide energy. In the absence of sufficient insulin, the body begins to metabolize stores of fat as an alternative source of energy when glucose cannot be used, producing ketones to provide the body with energy, which causes DKA (Tridgell *et al.*, 2010). The frequency and severity of DKA at presentation varies significantly worldwide. In the KSA, it has been shown that DKA is present in 55% to 77% of all T1DM cases (Habib, 2005).

### **Diabetes and School Meals**

A diabetic diet otherwise known as 'medical nutrition therapy' is a medically recommended diet which includes the consumption of nutritious foods in moderate amounts, eaten at regular mealtimes (Mayo Clinic, 2013). The diabetes diet is naturally rich in nutrients and low in fat and calories, with an emphasis on fruits, vegetables and whole grains, and avoiding items such as processed snacks, high-fat dairy products and high-fat animal proteins (Mayo Clinic, 2013). This type of balanced diet is highly beneficial in keeping glucose levels regularly under control,

and it therefore provides an ideal diet for children with diabetes in schools. The diabetic diet for children should be prescribed by a dietician with expertise in paediatric diabetes, as the insulin regimen should consider both the dietary habits and lifestyle of the child (Mayo Clinic, 2013). This should also take into consideration the daily routine of the child in order to include details relating to content and timings of meals and snacks and the correct insulin dose (Mayo Clinic, 2013). Regularity of meals should be emphasised, in order to support good eating habits, and food intake should be monitored closely and reviewed from time to time.

Meals should contain a starchy carbohydrate such as bread, cereal, potato, pasta or rice, as they ensure a stable release of glucose and do not cause any sudden fluctuations of blood glucose (Mayo Clinic, 2013). Sugary, carbonated drinks and sweet foods should be avoided since these cause sudden rises in blood glucose level. Meals should contain at least some type of fruit or vegetables (Smart *et al.*, 2009). Ideally children having breakfast in school should have a cereal which contains fibre, and sugary cereals should be avoided. Toast is also a good breakfast choice. Fruit, yogurts, milk and fresh fruit juices are all suitable at breakfast if available (Vliet *et al.*, 2007; Smart *et al.*, 2009). Although there is no special diet for children with diabetes to follow, eating correctly is important when managing diabetes. The diet should also be in accordance with cultural, ethnic and family traditions, and individualised to the needs of the child (Vliet *et al.*, 2007).

Children with diabetes may choose to have either a packed lunch or school meals. Ideally either meal should contain at least one source of starchy carbohydrate and preferably a milk product or fruit. This helps to maintain steady blood glucose levels throughout the day, with slower release of energy. Drinks should be either water or non-sugar diet drinks which do not cause spikes in blood sugar levels. Occasionally children may have fresh fruit juice or milkshakes as part of their lunch (Vliet *et al.*, 2007). Younger children with packed lunches should be supervised to ensure that they do not exchange their lunch with others, as parents may have calculated the necessary daily dose of insulin based on the content of the lunch box.

Younger children on school meals will have a fixed dose of insulin when parents are absent at lunchtime. Some children will have a carbohydrate counted meal to match the insulin dose. Older children may be allowed to alter their insulin dose depending



on what they choose to eat, but healthy choices are encouraged. Younger children should be supervised to ensure that they eat their school meal in order to prevent hypoglycaemia later in the afternoon (Vliet *et al.*, 2007). Nevertheless, one of the chief difficulties for children with diabetes in schools is that there are numerous problems that may arise. For example, it may be the case that school meal portions are not regular; their nutritional, calorific, or glycaemic index content is not labelled; or they may contain refined carbohydrates such as white bread, rice or pasta, or fruit juices, which cause fast increases in blood sugar levels.

This may mean that children with diabetes are unable to keep an accurate track of the food that they consume, which may in turn lead to excessively low or high blood sugar levels at school. In principle then, diet and nutritional management should be a key issue in the effective treatment and supervision of children with diabetes in schools. Indeed, the ADA recommends that the specific needs of the child pertaining to meals and snacks, including food content, amounts, and timing should be addressed specifically by schools and day care centres (American Diabetes Association, 2012). However, as noted by Matyka (2010), without robust guidelines and legal safeguards, and suitable provision of diet and nutritional management for children with diabetes, school authorities are unlikely to take this issue seriously. It is for this reason that educating schools and teachers about children with diabetes and their needs is of paramount importance.

## **THE SIGNIFICANCE OF THE RESEARCH STUDY**

T1DM is a life-long disorder which can be treated by a complex regimen of insulin injections, diet and exercise, and which greatly affects the life of patients and their families. This is particularly the case for children and adolescents with diabetes who may struggle to cope with the management of diabetes within the school environment. Children and adolescents may find it difficult to find medical and social support at school from teachers, staff, and other students. Indeed, a review of the academic literature has shown a dearth of research assessing teachers' knowledge and attitudes on the management of T1DM in Saudi schools (Gawwad, 2008). Yet high prevalence rates for diabetes exist across the Middle East, and particularly in the KSA.

Consequently, the integration of diabetes care and management within the school environment can provide the support needed for children with T1DM to treat and manage their condition effectively. Consequently, this study will add significantly to the limited knowledge about the care and treatment of T1DM among school children in the KSA. It will also significantly add to the limited knowledge regarding knowledge and attitudes of teachers to children with T1DM in the KSA. It is envisaged that the findings from this research may provide a rationale for formulation of school health policies that will be targeted towards the effective management of T1DM within the Saudi school environment.

## **THE RESEARCHER'S ENGAGEMENT WITH THE TOPIC**

From my personal point of view, I would state that I have been interested in this particular topic for a long time owing to my heightened level of awareness regarding the management of diabetes in children within the KSA. My primary motivations for this study come from my educational background in food science and nutrition, my career as a nutritionist within a Saudi government hospital, and Saudi academic environments as a lecturer. However, I developed a particular awareness of, and concern over, the treatment of children with diabetes in Saudi schools because I have raised two children who have T1DM.

I have personally encountered difficulties in treating the children within the Saudi school environment. I have also been able to contrast the care and treatment of my children whilst they have attended schools in the UK. It is by comparing and contrasting the school environment within the KSA and the UK that I became particularly interested in researching this area in greater depth. Finally, as a Saudi citizen, the research study has provided me with the opportunity to conduct research in my home country, as well as allowing me to make a contribution in return for the significant benefits that I have enjoyed as a Saudi citizen.

## **RESEARCH AIM AND OBJECTIVES**

### **Research Aim**

The aim of this longitudinal research study was to measure the effectiveness of a specifically designed intervention (a health education programme) on the knowledge and attitudes of primary school teachers over a six month period.

## Research Objectives

The research objectives incorporate the measurements of knowledge and attitudes of primary school teachers taken at pre-test (*baseline*), post-test (*3 months*), and post-test 2 (*6 months*) intervals. In order to achieve the research aim the following objectives were adopted.

- To establish pre-test, post-test, and post-test 2 measures for primary school teachers' knowledge and attitudes in the control groups and experimental groups.
- To administer the health education programme intervention to primary school teachers in the experimental group only, for a period of nine weeks.
- To compare the pre-test, post-test, and post-test 2 measures of knowledge and attitudes scores of primary school teachers in the control groups and experimental groups.
- To observe and assess any change in pre-test measures of knowledge and attitudes scores of primary school teachers in the control groups and experimental groups, compared to post-test measures three months after the health education programme intervention was administered.
- To observe and assess any change in pre-test measures of knowledge and attitudes scores of primary school teachers in the control groups and experimental groups, compared to post-test 2 measures six months after the health education programme intervention was administered.
- To examine the impact of socio-demographic factors (gender, age group, level of education) on the pre-test scores of primary school teachers in the experimental group based on their demographic survey responses.

- To examine the impact of socio-demographic factors (gender, age group, level of education) on the post-test scores of primary school teachers in the experimental group based on their demographic survey responses.

## **THE STRUCTURE OF THE PHD THESIS**

The PhD thesis is structured into six chapters and 12 appendixes. The thesis continues in chapter two with a wide-ranging, systematic literature review which provides a search strategy, a critical evaluation of the available evidence to date, a summary of outcomes of the more rigorous evidence, and a clear identification of a gap in the existing knowledge which demonstrated the need for this research study. Chapter three then provides a detailed account of the study design, together with justification of decisions about the sample, the nature of the intervention, the means of data collection, the plan of data analysis, and a discussion of ethical issues pertinent to the research and it provides a consideration of limitations of the study. The results of the study are reported in Chapter four which covers the findings relating to the different testing points (pre-test, post-test, and post-test 2). Chapter five provides an in-depth discussion relating to the researcher's interpretation of the findings and corresponding implications. Chapter six then provides explicit details of the messages from the study, and an explanation of the implications of the research study for national policy, local practice, and training requirements.

## **CHAPTER 2**

### **THE CONTEXT OF THE STUDY - MANAGEMENT OF T1DM IN SCHOOLS**

The needs of children with diabetes during school hours are wide-ranging (Matyka, 2010). The introduction of intensive diabetes treatment for children has placed increased demands on schools. For children with T1DM, the ability to monitor their blood glucose regularly, together with how to understand balancing insulin, food intake, and activity levels, is essential to help curtail potential future health complications such as diabetic keto-acidosis (DKA). Indeed results from the Diabetes Control and Complications Trial (DCCT) showed that tight control of blood glucose impedes the onset and slows the progression of long-term health complications, including diabetic retinopathy, nephropathy, and neuropathy. In addition, the trial demonstrated that failure to adhere to this treatment regime increased the risk of severe hypoglycaemia or hypoglycaemia in schools (The DCCT Research Group, 1993).

Although in theory the effective management of T1DM offers children with diabetes a vital opportunity to manage their condition more effectively in the long-term, in practice a diverse range of factors may affect this: national laws; living in a developed or developing country; geography; schools finances; diabetic knowledge, experience, and training of teachers; availability of diabetic facilities and supplies; and the school environment.

### **MAJOR HEALTH-RELATED ISSUES OF CHILDREN WITH T1DM IN SCHOOL**

#### **Hypoglycaemia**

Hypoglycaemia, or low blood glucose, is one of the most common problems of T1DM (Chiarelli *et al.*, 1999). Hypoglycaemia occurs when blood glucose levels drop and the body is unable to produce adequate energy for its activities (Liese *et al.*, 2006). In healthy people the body usually maintains blood glucose levels within the normal range of 4.4 to 6.1 mmol/L or 82 to 110 mg/dl. However, when blood glucose becomes too low, the body releases adrenaline to raise the body's blood glucose levels (Siminerio and Betschart, 1999). There are several causes of hypoglycaemia, including missing meals or snacks, taking too much insulin, illness, and participating in unintended strenuous activities or exercise (Ly *et al.*, 2014). In the event that a

child with T1DM experiences hypoglycaemia, it can usually be treated effectively and with ease.

However, hypoglycaemia has varying levels of severity and is usually categorised according to the symptoms that the child is exhibiting (American Diabetes Association, 2006). If hypoglycaemia is not recognised initially and subsequently leads to a severe hypoglycaemic state, it then becomes necessary to treat hypoglycaemia as a medical emergency, since failure to do so can lead to unconsciousness, and ultimately death (Ly *et al.*, 2014). The symptoms of hypoglycaemia can be mild, moderate, or severe. Symptoms of mild hypoglycaemia include dizziness, hunger, weakness, trouble concentrating, shakiness, tingling in extremities, sweating, fatigue, pale skin, palpitations, and occasionally headache and behavioural changes such as irritability and anxiety.

Symptoms may be detectable when hypoglycaemia is mild but some children, especially those under five years, may have little or no awareness of hypoglycaemia. Consequently close supervision and frequent blood glucose monitoring may often be needed. Children should be allowed to test their own blood glucose level and access emergency glucose if hypoglycaemia is suspected (Ly *et al.*, 2014). Moderate hypoglycaemia is also associated with drowsiness, confusion or aggressiveness, so someone else is usually needed to administer treatment at this stage since concentration and focus may be lacking in children. Severe hypoglycaemia symptoms include altered states of consciousness, and inability to take treatment orally because of disorientation, seizures, or even falling into a coma.

Treatment at this stage invariably requires glucagon intake (a hormone that raises blood glucose) or intravenous glucose administration (Harris *et al.*, 2001; Ly *et al.*, 2014). Teachers should also be aware that cognitive function can be affected for several hours after an episode of hypoglycaemia, therefore children may not perform as well as expected academically even after taking insulin or glucagon treatments. Children taking examinations should therefore be allowed to check their blood glucose level immediately before an examination, and to take food and drink with them in case of hypoglycaemic episodes (Rovet *et al.*, 1988; Rovet and Alvarez, 1997; Hershey *et al.*, 2004). Avoidance of severe hypoglycaemia should therefore always remain an integral part of managing T1DM.

## **Hyperglycaemia**

According to Siminerio and Betschart (1999), hyperglycaemia, or high blood glucose, occurs when the blood glucose level is too high. This may be due to too much food, insufficient insulin, stress or illness. High blood sugar generally does not put the person with diabetes in immediate danger. However, high blood glucose levels over long periods of time can lead to serious complications such as eye disease, kidney disease and nerve disease. High blood sugar over a few days can lead to the serious condition DKA. DKA occurs when the body begins to burn fat for energy since carbohydrate is not available and ketones are released which become dangerous if they build up in the blood stream.

DKA can be life-threatening, so early recognition is essential (Children & Young People Diabetes Team, 2011). The signs of high blood sugar are thirst, passing urine frequently, blurred vision, abdominal pain, increased hunger, nausea and vomiting, drowsiness, fruity breath, and short breathing. Children should be allowed to test their blood glucose level, drink water and use the toilet freely, if needed. If the child is wearing an insulin pump, pump failure or blockage should be suspected if blood glucose level is high and immediate action must be taken (ADA, 2006; Children & Young People Diabetes Team, 2011).

## **T1DM and Neurocognitive Dysfunction**

Several studies have found that neurocognitive functioning is compromised in children with T1DM. Two meta-analyses concluded that there is decreased functioning across numerous cognitive domains (Gaudieri, 2008; Naguib, 2009). The factor most consistently implicated in the long-term neurocognitive functioning of children with T1DM was their age at onset of diabetes, with studies concluding that those with early onset of T1DM had worse cognitive outcomes (Desrocher and Rovet, 2004; Ryan, 2006). Children with early onset showed poorer functioning later in childhood and adolescence across various domains of intelligence, school achievement, visual spatial ability, memory, motor speed, eye-hand coordination and attention, and executive dysfunction (Hagen *et al.*, 1990; Rovet, 1997; Northam *et al.*, 2001). Malone, Hanna, and Saporta (2006) demonstrated that continuous hyperglycaemia may be more damaging than intermittent hypoglycaemia in the developing brain. Although there is substantial evidence for neurocognitive deficits in children with T1DM, the causal mechanisms are still not well understood.

## **EATING, PSYCHOLOGICAL AND BEHAVIOURAL DISORDERS AFFECTING CHILDREN WITH T1DM**

According to Alnasir (2003), diabetes can exert a psychological impact on children who are diagnosed with the condition. The vast majority of children's waking hours are spent at school. In this environment, to facilitate learning and a positive experience overall, every child needs to feel comfortable and safe. This resonates especially for children with a chronic disease, such as T1DM, which already has the potential to infringe significantly on overall quality of life. Children and adolescents are certainly concerned about fitting in with their peers (Getch *et al.*, 2007; Snyder *et al.*, 2008; Endedijk *et al.*, 2015).

Having diabetes and managing the disease properly can set a person apart in a way that may create feelings of anxiety and insecurity, especially for school children. Consequently, it has been argued that having the ability to manage stress, cope with the disease, and solve problems are equally important to healthy development as the medical management of the disease (Getch *et al.*, 2007). Children, particularly adolescents, living with T1DM are at increased risk of depression, anxiety, and eating disorders. Mental health co-morbidities of diabetes decrease compliance with treatment and thus increase the risk of serious short-term and long-term complications (Kakleas *et al.*, 2009).

### **Eating Disorders**

The prevalence of eating disorders in children with T1DM is reported to be between 8% and 30%, which is significantly higher than their non-diabetic peers (Blanz, 1993; Pound *et al.*, 1996; Du Pasquier-Fediaevsky *et al.*, 2005; Wysocki *et al.*, 2005). Eating disorders in children are generally seen more commonly in adolescent girls (37.9%) as compared with boys (15.9%) (Neumark-Sztainer, 2002), and less common in pre-adolescent girls (17%) (Colton, 2007). Bulimia nervosa (BN) and binge-eating disorders (BED) are the most common in young people with T1DM, whereas anorexia nervosa is rare (Takii *et al.*, 2002). BN is characterised by excessive consumption of food which is not part of the scheduled meal plan. The main difference between BN and BED, is that the former is characterised by purging more than twice per week (Takii *et al.*, 2002). Patients may also resort to insulin omission in order to prevent weight gain. This can lead to other complications, such as poor control of blood glucose and frequent episodes of DKA (Takii *et al.*, 2002).



## **Psychological and Behavioural Disorders**

Depression is an internalising disorder that may increase with the duration of diabetes in some people (Dantzer *et al.*, 2003; Northam *et al.*, 2005). Depression is a psychosocial issue that can affect a child with T1DM, and even a decade ago it was fast becoming prevalent among adolescents with T1DM (Massengale, 2005). Currently, overall levels of clinical depression are significantly higher in adolescents, but at the same time medical treatment regimens using psychological therapies and antidepressant medications such as selective serotonin reuptake inhibitors (e.g., Prozac, Zoloft, Paxil, Celexa, Lexapro, Luvox) have also been shown to be effective in treating long-term clinical depression. Some depressive symptoms are sadness, apathy, distractibility, lethargy, sleep disturbances, appetite changes, low motivation, anger, irritability, tantrums or outburst, headaches, and stomach ache (Naranjo and Hood, 2013).

Diabetes is a difficult disease for children to cope with, and coupling it with depression can make it more demanding to manage, especially since depression may even accelerate some of the underlying complications (Musselman *et al.*, 2003). For instance, Hood *et al.* (2006) identified depression in children and adolescents with T1DM as being associated with negative diabetes health outcomes, such as recurring DKA admissions and poorer glycaemic control. Kokkonen and Kokkonen (1995) found the prevalence of symptoms related to depression in children aged 8 to 12 years and in adolescents with T1DM to be 12% and 18%, respectively. Schiffrin (2001) noted that adapting to diabetes and controlling the disease metabolically was negatively affected by depression and the symptoms with which it was associated.

In a study of 528 adolescents, Corathers *et al.* (2013) confirmed the link between more depression symptoms and poorer diabetes management and control. Indeed, for children and adolescents with T1DM, the rates of depression are double that of their peers without diabetes (Fleming *et al.*, 1993; Anderson and McGee, 1994). These are relatively high rates, and depression in children and adolescents with diabetes may be less noticeable to parents and teachers as compared with disruptive behaviours. Therefore the signs of (or the onset of) depression in children needs to be monitored carefully in practice.

Anxiety is another internalising disorder that seems to be increasing and is generally more prevalent in girls than in boys (often connected with the fear of hypoglycaemia). A person's adjustment to diabetes shortly after diagnosis seems to predict their adjustment later on (Dantzer *et al.*, 2003; Northam *et al.*, 2005). Studies have found that 9-19% of adolescents with diabetes suffer from anxiety (Grey, Whittemore, Tamborlane, 2002; Leonard, 2002; Dantzer *et al.*, 2003; Northam *et al.*, 2005). Furthermore, family characteristics have major implications on a younger person's adjustment to diabetes, self-management, and overall quality of life. Children and adolescents living in families with a high degree of conflict or that are less caring appear to have poorer metabolic control (Dantzer *et al.*, 2003; Northam *et al.*, 2005).

When a child is diagnosed with T1DM, parents and family become the most influential individuals in ensuring that the daily diabetes management regimen is maintained. Hauser *et al.* (1985) found that family attitudes toward independence, participation in social and recreational activities, and organisation, were all strongly correlated with children's perceived proficiency and diabetic adaptation. Although there is a lack of recent research into this area, past research has shown that support by family and friends can be vital for successful management of T1DM in children, especially in regards to effective glycaemic control (Jacobson *et al.*, 1994; Jacobson *et al.*, 1997; Siminerio and Betschart, 1999; Landolt *et al.*, 2002).

Psychological and behavioural issues in children with T1DM may lead to other problems, such as children being excluded from sleepovers, birthday parties, and summer camps due to parental anxiety (Naranjo and Hood, 2013). They may also lead to expanded parental roles (because of increased diabetes supervision) which may often develop into feelings of excessive control, nagging or chastisement being displayed (Naranjo and Hood, 2013). Some children with diabetes may feel constantly anxious or stressed, because of perceived excessive supervision at home, and feeling outcast or even bullied at school. Psychological symptoms may in turn lead to a wide number of outcomes, including the development of externalising disorders, such as impulsivity, hyperactivity, and aggression (Grey *et al.*, 2002; Leonard, 2002; Dantzer *et al.*, 2003; Northam *et al.*, 2005).

Diabetics with associated psychological disorders need closer follow-up in terms of diabetic control and appropriate psychological interventions. In light of this it can be

argued that targeting children with diabetes-related psychological issues (i.e., fear and feelings of discrimination, adjustment to major life changes and acceptance of diabetes, self-worth and peer group pressure) should be regarded as an integral part of diabetes management in schools. Indeed a number of studies have reported on the bullying and verbal abuse to which children with diabetes have been subjected at school (Amillategui *et al.*, 2007; Wilson and Beskine, 2007). Siminerio and Betschart (1999) noted that a child's friends may often be apprehensive, because they do not understand diabetes or what it means to have the disease.

Guthrie *et al.* (2003) proposed that not only should parents strive to work closely with their children's schools and day-care centre to ensure that their child is included in social activities, but also that those schools should aim to provide opportunities for open discussion of diabetes issues by children with diabetes peers. Other psychological problems have been reported. For instance, Naranjo and Hood (2013) stated that living with diabetes can feel overwhelming for parents and children, especially because of the constant vigilance that is required. Since children spend much of their time in school, it is important for school teachers and personnel to be aware not only of the medical aspects of managing T1DM, but also of the psychosocial needs of children and adolescents in keeping them safe.

## **SCHOOL MANAGEMENT CHALLENGES FOR CHILDREN WITH T1DM**

Perhaps the first step to increasing openness and transparency of the management of T1DM in school children may be to ensure that comprehensive information, knowledge, and literature on diabetes is available within schools. This may in turn lead to more widespread acceptance of the condition within the school environment. Children need to be able to manage their disease in a safe environment in which they feel comfortable, be it at home, with friends, or at school. To assure all of the elements necessary for the promotion of positive quality of life, school personnel must possess the knowledge and skills necessary to ensure adequate safety, care and psychosocial support for children with T1DM.

### **The School Diabetes Plan**

An extremely important component of diabetes management at school is the availability of the 'school diabetes plan' or what is sometimes termed the 'diabetes medical management plan' for each child with T1DM. This plan details the

requirements of managing the condition and how these requirements will be provided in practice throughout the school year (Centers for Disease Control and Prevention, 2014). The plan's details include: (1) when and where to check the blood glucose level; (2) how to identify and treat the child's usual signs of hyperglycaemia and hypoglycaemia; (3) measures to take regarding physical activities and sports; (4) appropriate snacks and meals; and (5) emergency medical plan (ADA, 2011; Nemours Foundation, 2014).

This plan should be kept in a location that is easily accessible by the school nurse, diabetes-trained teacher or any other authorised personnel. All children with T1DM should have this care plan activated in the event of an unforeseen diabetic episode even if they are normally capable of self-care. That some children or adolescents might be able to manage their diabetes requirements independently should not be taken as an excuse for not having the school care plan. Indeed the age or experience of the children with diabetes in managing their diabetes do not exclude the possibility of hypoglycaemia, DKA, or diabetes-related emergencies during school hours, all of which necessitate the immediate intervention of school personnel (ADA, 2011; Nemours Foundation, 2014).

### **Diabetes Training and Education for School Personnel**

Children and adolescents rely on school personnel to tend to their health care or medical needs while they are in a school setting. Ensuring the health and safety of a child or adolescent with T1DM at school may often depend upon the knowledge that school nurses and other school personnel have regarding the care and proper management of the disease. In principle, school personnel should therefore be educated and trained for blood glucose testing, insulin and glucagon administration, and recognition of, and intervention for, medical emergencies. This also requires that a knowledgeable adult be present to perform these procedures when the child is on a field trip or is participating in extracurricular school-related activities (ADA, 2006).

In addition to possessing knowledge about the necessary elements of diabetes management, school nurses and personnel also need to be trained in the use of new medical technology for diabetes management. Children and adolescents now have access to new diabetes technology such as digital blood glucose meters and insulin delivery systems including pumps (continuous subcutaneous insulin infusion), and

pens (insulin delivery system that carries insulin in a self-contained cartridge). These developments in technology have certainly made it easier for children and adolescents with T1DM to manage their blood glucose levels and daily insulin intake.

However, the range of technologies means that school personnel may find it difficult to know how to operate all the devices that may be involved. For instance, different types of insulin pens are available from Medicoool (pen and cool bag), KlikSTAR (reusable pen), Nomad, Insupen (pen needles), MaboxDiabete (pen and pump), Timesulin (flexible pen), NeedleBay and others. Blood glucose monitoring systems are available from Accu-Chek (digital monitor), SD Biosensor (monitoring test, strips, lancets), Home Health UK Ltd (lancets), Easy Life (digital monitor), and 2in1 Smart Glucometer (blood glucose adapter for Apple iPhone and iPad).

Over a decade ago, studies showed that many school nurses and personnel may not have been skilled in using these innovative technologies (Siminerio and Koerbel, 2000). Now, it may be the case that schools and school nurses are more aware of new medical technology for diabetes management, but it is highly unlikely that all school personnel are trained in the knowledge and use of all diabetes technology. In reality, this is what may be required in order for schools to maintain effective school diabetes plans and diabetic response systems. There would also seem to be a paucity of information regarding glucagon administration in the literature, with Harris *et al.* (2001) even noting family members of individuals with diabetes being unaware of how to use glucagon within the diabetic regime. Those closest to diabetic individuals did not have adequate knowledge.

Frank and Daneman (1998) considered it unreasonable to expect school personnel to respond to severe hypoglycaemia with glucagon, rather they believed that an ambulance should be called. Although this was based on diabetes regimes existing more than 15 years ago, not only does it highlight the potential legal liability issues involved, but it shows that schools need to address these concerns before they occur, and have well-established and known diabetic 'best practice' response procedures in place. Yet in a study by Lewis *et al.* (2003), 9% (6 of 65) of schools that were surveyed in the USA did not have a policy concerning diabetes management, and nearly 17% of the schools did not have staff trained in diabetes management. Of those same 65 schools that were polled, 80% responded that they

had children with diabetes on the register (Lewis *et al.*, 2003). In the UK, Greenhalgh (1997) surveyed teachers and found 61% to have inadequate knowledge regarding diabetes.

In a survey of nurses (n=38) in the USA, Nabors *et al.* (2005) found that 95% of elementary and 89% of middle and high school nurses agreed that teachers and other school personnel need to improve their knowledge about diabetes. It was concluded that support for diabetes management might be facilitated by educating school staff, and improving lines of communication between children, adolescents, parents, school nurses, teachers and physicians (Nabors *et al.*, 2005). A survey of schools in the USA by Wagner and James (2006) sought to measure the knowledge of school counsellors (n=132). It was found that school counsellors possessed only a basic level of diabetes knowledge, which was inadequate to give appropriate assistance to children with T1DM (Wagner and James, 2006). This pilot study found that compared to school counsellors with no formal diabetes training, those school counsellors who had had some diabetes training held more knowledge regarding diabetes and its management in school children (Wagner and James, 2006).

Although this pilot study was not followed up, another study in the USA by Wagner *et al.* (2004) on children with T1DM (n=58) and their parents investigated the relationships among diabetes control, perceived school experiences and quality of life. It was found that children had better diabetes control when school personnel had received diabetes training, and children had better quality of life when classmates had received diabetes training (Wagner *et al.*, 2004). It was also found that "children who reported greater flexibility in performing diabetes care tasks at school had significantly better diabetes control than children who reported less flexibility" (Wagner *et al.*, 2004, p.764). This study therefore lends support to the belief that increasing levels of knowledge and awareness of diabetes and diabetes management of school personnel and other students may, in practice, improve overall levels of diabetes control and quality of life for children with T1DM in schools.

### **School Personnel Concerns for Blood Glucose Monitoring and Insulin Injection**

The concerns of school personnel are understandable when it comes to the burden of dealing with T1DM. These may include blood contamination in cases of insulin injection; legal liability in case of assisting errors; the provision of private rooms for

insulin administration; safe locations for storing diabetes medication; and a lack of funding to hire trained healthcare professionals. However, given the inherent health risks to children with diabetes, schools and local authorities have a clear duty to ensure a safe environment for children with diabetes in schools. In the UK, a recent diabetes survey found that of nearly 3000 schools sampled, almost 50% had no policies to supervise or perform blood glucose monitoring (Matyka, 2010). Furthermore, 41% of schools had no policies for staff to supervise the giving of diabetes medication, 60% had no policy to undertake insulin injections, and 70% of schools expected parents to come to school to give injections if children were unable to inject themselves (Matyka, 2010).

Another study found that treatment of diabetes was frequently performed away from the classroom, which impacted negatively on class attendance, metabolic control, and emergencies (Marks *et al.*, 2013). Consequently, it was argued that there was an increased need for diabetes educators to work in collaboration with children, parents, and school personnel to integrate diabetes care into schools more effectively (Marks *et al.*, 2013). The recent survey by Matyka (2010) of nearly 3000 schools clearly highlights the lack of priority given to the management of diabetes in schools. This is despite the UK being a developed country with schools which are well-established and which have financial and other resources in place to help with the management of children with diabetes. Yet many schools in the UK have policies in place to address issues regarding truancy, sex education, bullying, and depression, but no policies in place to address issues that may pose equally significant health risks to children and adolescents with diabetes.

Younger children, especially those in primary schools, may need an adult to perform their glucose monitoring or insulin injection at school (Children & Young People Diabetes Team, 2011). On the other hand, older children may be fully competent to manage their own diabetes whilst at school and should be encouraged to do so. The child may wish to carry their own diabetes equipment or may prefer it to be kept in a suitable place in school in order to ensure that equipment is not left at home by mistake. Provision of safe storage areas for insulin and blood glucose meters, and private areas for insulin administration are therefore necessary in practice (Nabors *et al.*, 2003; Hayes-Bohn *et al.*, 2004; Wagner *et al.*, 2004).

In the absence of a private location for performing insulin injections, some children might be compelled to administer medications in the toilets which may be unsanitary, and may lead other children to believe that they might even be self-harming or taking drugs (Newbould *et al.*, 2007). Like other school systems around the world, the KSA generally lacks the policies to ensure a safe and healthy environment for pupils with T1DM. Consequently it is vitally important to ensure the implementation of diabetes training for teachers and school personnel, together with clear policies on diabetes management (Gawwad, 2008).

### **Inadequately Trained School Personnel**

Staffing issues for school nurses are another major challenge faced by schools (Schwab and Gelfman, 2001). From a strategic perspective, school nurses are charged with planning and implementing school health programmes, delivering health services to students, conducting health education classes, providing necessary counselling to students, and advocating on behalf of children and adolescents for their health rights (Schwab and Gelfman, 2001). In a survey conducted by Nabors *et al.* (2005), school nurses reported that school staff need to have a better understanding of what to do if blood glucose levels become too high or too low. Many of these same school nurses also noted that all adults (bus drivers, teachers, parent volunteers) should possess some education regarding the daily management of diabetes (Nabors *et al.*, 2005).

In a study conducted by Brener *et al.* (2001) in the USA, 92% of states, 94% of school districts, and 97% of schools surveyed allowed school faculty and staff to administer prescription drugs to students (as long as it was approved by the parent and documented). In Australia, Marks *et al.* (2013) found that most schools did not have nurses to assist with diabetes care, and therefore teaching and administration staff members were responsible instead. School teachers and personnel may, therefore, be used to assist in administering diabetes medication by choice or by necessity, but in either case the same outcome should be attained which is increased support for children with diabetes.

One of the major advantages of training school personnel, especially teachers, in the daily management and emergency regimen of diabetes care, is that they are ideally situated to recognise children who are having difficulty with their emotional and



academic progress (Greenhalgh, 1997). Even full-time school nurses are not necessarily in the classrooms, on field trips, or present at extracurricular activities to assist the child if necessary. However, reviews of the low level of knowledge and experience of school personnel regarding diabetes management highlights the difficulties, in terms either of finances or time that schools face regarding this issue.

## **OTHER PRACTICAL CHALLENGES IN SCHOOLS FOR CHILDREN WITH T1DM**

Diabetes is a disease that requires round-the-clock management, and may therefore present particular difficulties in schools. Much care and attention has to be provided for a child with T1DM of school age, as schools are essential places where health interventions can play a significant role in minimising the risk of complications associated with diabetes in schools children (Melton and Henderson 2007). The dynamic nature of the daily schedule at school (influenced by physical education classes, participation in sports, break times, school trips, illnesses, and extracurricular evening activities) may complicate the management of T1DM for children at school significantly (Schwartz *et al.*, 2010).

Children's growth requires continual changes to be made to the individualised treatment plan. Accordingly, decisions related to changes in insulin or carbohydrate intake requirements have to be taken while children are at school. Faced with these complex health and logistical challenges, it is therefore essential that schools equip their personnel, in particular teachers who have the greatest exposure to children, with the appropriate knowledge and skills in each of these areas (ADA, 2011). Efficient diabetes management in schools is essential for the promotion of a healthy and productive academic environment for children with diabetes. In theory this will be an environment that will be encouraging and facilitating for school children, and which will also allow children and adolescents with diabetes to participate actively in school activities. This will not only minimise the disruption of classroom activities that might be caused by diabetes-related emergencies, but may also promote normal physical and emotional growth and development in the long term (ADA, 2006).

### **Academic Performance**

Meo *et al.* (2013) studied the academic performance of 36 Saudi students with T1DM, and matched non-diabetic control students from eight schools. The scores obtained in written examinations in English, mathematics, physics, chemistry,

biology and humanities were used to determine their academic grades. It was found that students with T1DM obtained significantly lower academic grades compared to their non-diabetic control classmates ( $86.58 \pm 1.48$  vs  $90.62 \pm 1.36$ ) (Meo *et al.*, 2013). Meo *et al.* (2013) concluded that the significant decline in academic performance could be explained by an association between diabetes and cognitive function. The results of this study should be interpreted with caution, however. The study by Meo *et al.* (2013) only used 36 students with T1DM (plus 36 control students). Yet another study into the impact of T1DM on the development of functional academic skills in children with T1DM in schools in the USA ( $n=244$ ) found evidence to contradict this conclusion (McCarthy *et al.*, 2002). Furthermore, this study used a sibling control group ( $n=244$ ) and an anonymous matched classmate control group ( $n=209$ ) (McCarthy *et al.*, 2002).

Another study by McCarthy *et al.* (2003) of children with T1DM ( $n=244$ ) in the USA, showed that children with serious hypoglycaemia and increased hospitalizations did demonstrate lower academic achievement. These studies would tend to show that there may in fact be a causal link between T1DM and academic underperformance, but that moderating factors may be either cultural (e.g. USA v. KSA) and/or specific to particular symptoms (e.g. severe hypoglycaemia and hospitalizations may impact on time spent learning and studying more). Indeed school absenteeism, whether intentional or unintentional, is another issue which may potentially affect the academic performance for a school-aged child with T1DM.

Vetiska *et al.* (2000) found that children with diabetes miss an average of six more school days per year than healthy siblings. For those children with more serious and recurring T1DM symptoms such as DKA or hypoglycaemic episodes, this time period may increase significantly. Frequently missing school days can certainly affect a child's performance academically, and it can also influence psychological issues related to self-confidence and maintaining relationships with classmates. Additionally, stress related to making up missed homework can also ensue, especially for children who have more methodical or achievement-orientated personalities (Vessey *et al.*, 1996).

## **Physical Education in School**

Hanas (2007) recommended exercise for all children and young people to improve cardio-respiratory and muscular fitness as well as bone health. People with diabetes are more at risk of heart disease than the general population, so it is essential that children with diabetes are not excluded. Physical education teachers must be aware that children have diabetes and how exercise may affect their diabetic control. Exercise uses fuel (carbohydrate or fats) and therefore lowers blood glucose levels in the body. Children with T1DM are therefore more prone to develop hypoglycaemia during or after exercise.

In the USA, the National Diabetes Education Programme reported that low blood glucose levels can be prevented by eating a small snack or drink containing carbohydrates (biscuits, fruit, cereal bars) before or during exercise (U.S. Department of Health and Human Services, 2012). It was also recommended that for students undertaking prolonged exercise (more than 45 minutes), physical education teachers, coaches, or athletic trainers should have glucose tablets or other quick-acting forms of glucose readily available in the gym or training field (U.S. Department of Health and Human Services, 2012). Older children and adolescents in schools may alter their insulin regime around exercise, and may therefore not require a snack (Hanas, 2007).

## **School Excursions**

Children with diabetes should not be prevented from going on school trips or overnight excursions simply because of their medical condition, as this may exert a negative impact on them psychologically (Hanas, 2007). Indeed full participation in all academic, social and sporting activities should be encouraged as development of self-esteem and confidence in such activities can have positive effects on the management of diabetes (Robertson *et al.*, 2009). Children are likely to be more active during school trips so diabetes management will need to be planned for in advance and adjusted accordingly. Careful planning is necessary as insulin doses may need to be reduced, extra carbohydrates may be required, and additional supervision and blood glucose monitoring may be needed to prevent hypoglycaemia (Robertson *et al.*, 2009).

It is recommended that school staff meet with the parents and the diabetes care team to discuss the child's needs. Ideally, this should be undertaken with the child present in order to increase the participation of the child in the management of diabetes within the school setting. Including the child in such discussions may empower the child as he or she can see the involvement and interaction of school staff and parents (whereas exclusion may induce or exacerbate feelings of isolation or helplessness in the child). Appropriate action plans to enable the child to participate fully and safely in the school trip can then be tailored carefully to the child's needs. A copy of the itinerary and sample food menus should be available at this meeting. Menus can be carbohydrate-counted to help decision-making about insulin doses (Robertson *et al.*, 2009).

## **CONCLUSION**

More demands are being placed on schools to manage for children with T1DM better. Non-treatment of diabetes can lead to long-term health complications, such as diabetic retinopathy, nephropathy, and neuropathy, but short-term failure to comply with treatment regimens can also lead to severe cases of hypoglycaemia, hyperglycaemia, and DKA. It is essential for teachers to learn the warning signs or symptoms that would indicate that children with T1DM may need diabetes medication or emergency medical assistance. Exposure to hyperglycaemia after a few days may result in DKA, which can be life-threatening.

The literature emphasizes the need for teachers to obtain basic knowledge of T1DM in children, but children with T1DM are also likely to experience many psychosocial issues. They often struggle with fitting in with their peers, or in school environments due to their management and treatment needs. Teachers must monitor children with diabetes closely in order to safeguard their psychosocial wellbeing in school.

The study reported on here was stimulated by the growing number of children with T1DM and the need to manage their condition at home and at school; the lack of education interventions on T1DM for teachers; and the general attitudes of teachers and school personnel towards T1DM management.

## **CHAPTER 3**

### **LITERATURE REVIEW**

#### **RATIONALE FOR THE REVIEW**

The role of school teachers and personnel in helping to manage T1DM within educational establishments is central to the thesis. Consequently this chapter was structured with a view to providing a review of the relevant literature in this area. This chapter is a report of a systematic search for, and appraisal of, evidence regarding T1DM management in schools, and the knowledge and attitudes of school personnel towards children with T1DM. It also provides a summary of literature relating to the effectiveness of school teacher diabetes health education programmes.

Multiple study designs were examined rather than restricting the evidence to a single study type or specifically only randomized controlled trials in order to provide a more comprehensive picture of the evidence. Furthermore, owing to the heterogeneous nature of the evidence, it was necessary to adopt different assessment criteria for differing research designs, and this limited the overall ability to effectuate a comparison between studies.

Of the various types of reviews of the literature categorised by Grant and Booth (2009), this literature review best reflects a mixed-methods approach (also known as integrative or comprehensive review) in terms of assessing and synthesizing relevant research. A largely positivist position was adopted especially for the quantitative part (i.e. the assumption that only observable phenomena will lead to the production of robust data). A structured methodology was used with the emphasis being on quantifiable observations, in order to facilitate replication (Paul, 2005).

#### **SEARCH STRATEGY**

The literature search was carried out following the guidelines for systematic reviews published by the Centre for Reviews and Dissemination (CRD, 2009) and the guidelines for comprehensive or mixed method reviews published by the Joanna Briggs Institute (Joanna Briggs Institute, 2014).

The PICOS framework (Population, Intervention, Comparator, Outcomes and Study Design) was used for the quantitative component. Studies describing the perceptions

of parents, children and teachers were considered for the qualitative component (CRD, 2009).

The review questions were:

1. What are the perceptions of children with T1DM and their parents about diabetes care in schools?
2. What are the knowledge and attitudes levels of school teachers and other school personnel regarding helping children in the management of T1DM in school?
3. What is the effect of a school diabetes educational programme on the knowledge and attitudes of school teachers and other school personnel regarding helping children in the management of T1DM in school?

Based on these questions PICOS was defined as follows:

- Population: School teachers and school personnel including school nurses responsible for helping children in the management of T1DM in the school.
- Intervention: Health education programmes regarding management of T1DM in the school.
- Comparator: Studies that compared the effects of the intervention with no intervention, or pre-test post-test studies.
- Outcomes: Change in the knowledge and attitudes of school teachers and school personnel regarding helping in the management of T1DM in the school.
- Study design: randomised controlled trials and quasi-experimental studies, qualitative studies, surveys.

## **Search Process**

Boolean logic was applied to search for literature related to the study topic. This approach allowed the researcher to perform advanced search queries using Boolean operators to connect keywords (and, or, not), and to make refinements that helped to narrow or pinpoint the focus of the search (Barker and Barker, 2014). Many search engines are equipped for keyword searches only, so the researcher looked for databases designed for the use of Boolean operators and that contained health-related articles. Based on this rationale, the databases searched were PubMed (Database of the National Library of Medicine), EbscoHost (Academic Search Complete and CINAHL) and Science Direct.

The keywords employed were childhood diabetes, juvenile diabetes, paediatric diabetes, type 1 diabetes, and insulin dependent diabetes. These were adopted in order to capture differing references to the condition, diabetes and school, school health promotion, teachers' education, managing T1DM in school and teachers' knowledge and attitudes. MeSH headings were also used to search in PubMed.

The search for published articles was made to cover a period extending from 1983-2016, as 1983 represents the year of the first study found in a pre-search of teachers' knowledge and attitudes towards children with diabetes carried out in the UK. In order to gain a comprehensive, broader knowledge and understanding of school issues related to diabetes and its management, the search also included all school children, although the main focus of this study was on teachers and children in primary schools.

A manual search of journals specific to the study region (Eastern Medical Health Journal and Saudi Medical Journal) was carried out. The websites of key organisations for childhood diabetes were scrutinised for guidelines and policy recommendations relating to the management of T1DM in children (for example, Diabetes UK, IDF, ADA, and WHO). References and bibliographies present in identified articles were then also used to find supplementary literature on school teachers' knowledge and attitudes, as well as the effectiveness of health education programmes for school teachers regarding school children with T1DM. Finally, specific inclusion and exclusion criteria for research studies were also formulated.

### **Inclusion Criteria**

Published studies that satisfied the following criteria were included in the literature review.

- Primary studies and reviews or policy guidelines on childhood diabetes
- Focussed on perceptions of children and their parents about management of T1DM in school

OR

Focussed on knowledge, attitudes and practices of school teachers and other school personnel including school nurses about T1DM in school

OR

Primary studies that determined the effectiveness of educational interventions regarding management of T1DM in the school setting.

### **Exclusion Criteria**

Items which satisfied any of the following criteria were excluded from the literature review.

- Studies published in a language other than English
- Studies that focused on adults with diabetes
- Unpublished studies
- Studies published before 1983
- Focussed on medical diagnosis or treatment

### **Search Results**

The search results are summarized in Figure 2. The first step in the search process was applying the keyword search. Next, the titles and abstracts of all articles were tested against the exclusion criteria, erring on the side of over-inclusion when in doubt (i.e. when information available from the abstract alone was not adequate to make a decision). As a result, a total of 1496 potentially eligible records were retrieved from PubMed, 6981 studies were retrieved from Science Direct, and 1750 studies from Ebscohost.

After the application of the inclusion criteria, a total of 124 articles were found to be eligible (PubMed=85, Science Direct=18, Ebscohost=21). Five additional articles from organisational websites and major diabetes-related guidelines, and six systematic reviews of the literature were also added to the total. References and bibliographies present in these articles were then used to find four supplementary articles.

Removal of duplicate studies resulted in a total of 90 eligible studies. These studies were then further reduced through closer inspection and repeat application of the exclusion criteria. The studies excluded were of non-relevance to the topic under review, focussed on medical diagnosis or treatment, had unclear findings, were non-compliant with the guidelines of various diabetes organisations or were not primary studies.



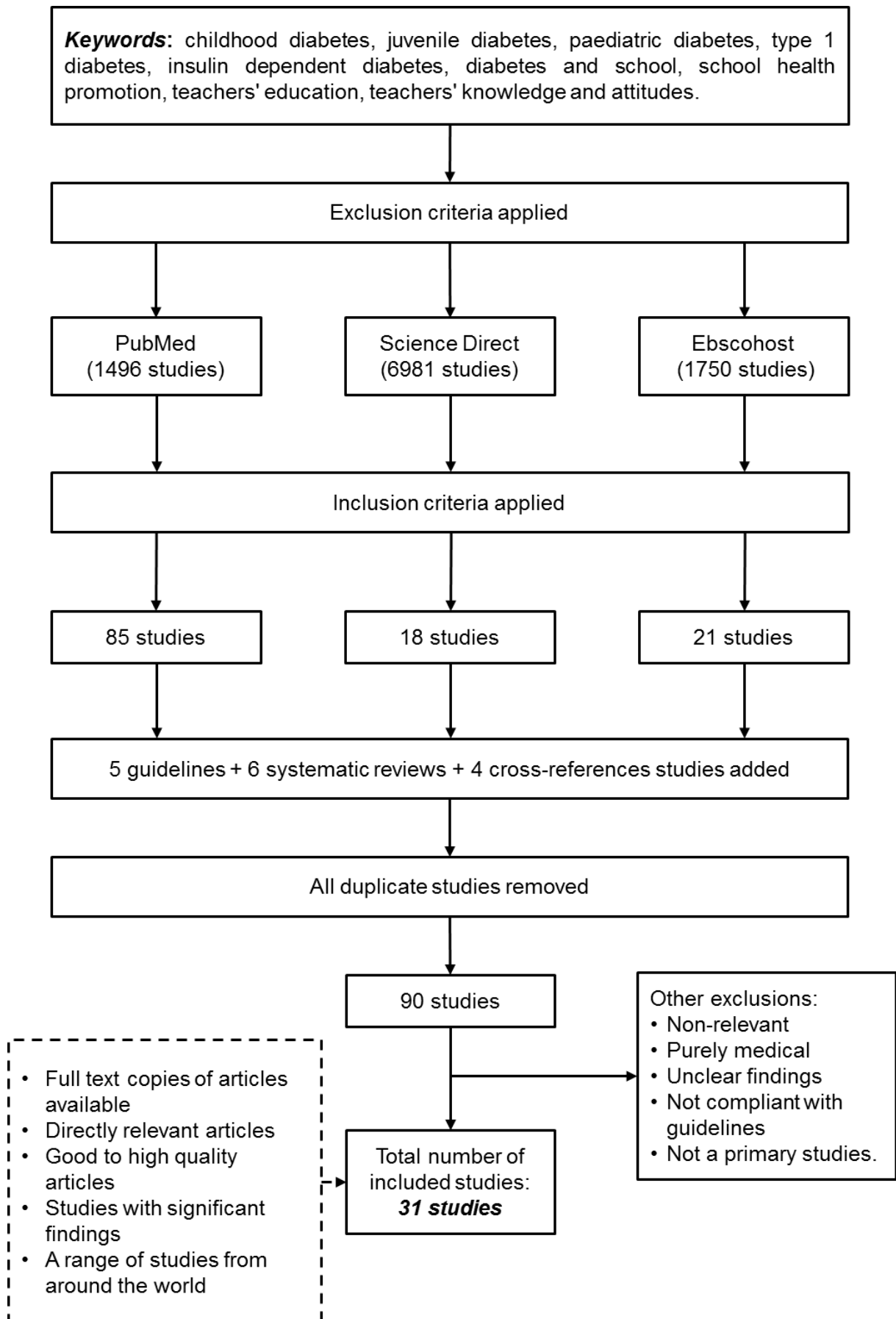
At the end of this extensive search and limitation process a total of 31 studies which satisfied the inclusion and exclusion criteria were included in the literature review. The types of these studies are listed in Table 2.

Thirteen of these studies dealt with perceptions of parents or children regarding management of T1DM in the school setting, 11 studies assessed the knowledge and attitudes of teachers regarding T1DM, and 7 studies assessed the effectiveness of education programmes for teachers. Most of the studies in this review were undertaken in the UK, the USA or Europe, with few conducted in Asia. Few studies were found to have been completed in the KSA, with only one article (Gawwad, 2008) found on the assessment of teachers' knowledge and attitudes on management of T1DM in children.

### **Critical Appraisal**

The full text articles were examined keeping in mind the PICOS framework. The CASP tools for randomised controlled trials and for qualitative studies were used for critical appraisal of the items (Critical Appraisal Skills Programme, 2013). The three broad issues considered were (i) are the results valid; (ii) what are the results; and (iii) will the results help locally.

**Figure 2: Search Strategy**



**Table 2: The types of studies that were obtained**

Study Types	Number
Primary studies dealing with parents' or children's perceptions of T1DM management in the school setting	13
Primary studies dealing with knowledge and attitudes of school personnel	11
Primary studies dealing with the effectiveness of teachers' education programmes about diabetes	7
<b>Total</b>	<b>31</b>

### **THE PERCEPTIONS AND EXPERIENCES OF CHILDREN WITH T1DM AND THEIR PARENTS REGARDING THE SCHOOL MANAGEMENT OF DIABETES**

The research literature highlighted issues that arose when diabetes treatment was not well-integrated into the school setting. These issues were identified by children, parents, and school personnel via questionnaires, surveys, and interviews, and have been summarised in Table 3.

Data categories extracted included (i) school systems in different places and local legislation if any; (ii) the support received at the school for blood glucose testing, insulin administration, and recognition and response to hypoglycaemia; and (iii) school rules regarding storage of insulin, glucometer, availability of designated place for testing and insulin administration, access to snacks/drinks and toilets and diet choices available for children with diabetes. Discrimination against children with diabetes was also recorded. Due to the qualitative nature of most of the studies, synthesis is essentially narrative in nature.

It was found that school systems varied across countries so the evidence is presented correspondingly. Most of the published studies were from the USA (50%), with some additional studies from the UK, Spain, Italy, Australia and Taiwan.

**Table 3: Studies describing perceptions and experiences of children with T1DM and their parents regarding school management**

Author	Place	Study design	Population
Hayes-Bohn <i>et al.</i> (2004)	USA	Semi-structured interviews Qualitatively analysed	30 adolescent girls and their parents
Amillategui <i>et al.</i> (2007)	Spain	Self-reporting questionnaire	499 parents
Hellems and Clarke (2007)	USA	Survey	185 parents from 153 schools
Newbould <i>et al.</i> (2007)	UK	Face-to-face semi-structured interviews	26 children and their parents
Wilson and Beskine (2007)	UK	Survey	73 children and their parents
Jacquez <i>et al.</i> (2008)	USA	Survey	309 parents
Lin <i>et al.</i> (2008)	Taiwan	Semi-structured interviews	12 mothers of children aged 7 to 9 years
Amillategui <i>et al.</i> (2009)	Spain	Survey	430 children, their parents and teachers
Diabetes UK (2009-2010)	UK	Survey	Nearly 3000 schools
Schwartz <i>et al.</i> (2010)	USA	Survey	80 children and their parents
Pinelli <i>et al.</i> (2011)	Italy	Survey and semi-structured interviews	220 parents and 52 school teachers
Kime (2013)	UK	Semi-structured interviews	116 children and 141 parents
Marks <i>et al.</i> (2014)	Australia	Survey	66 parents of children in Kindergarten year 1 & 2

### Research in the USA

Three federal laws protect the rights of children in the USA to obtain the care that they need while in school. These are: (1) Section 504 of the Rehabilitation Act of 1973; (2) the Americans with Disabilities Act 1990 (ADSA); and (3) the Individuals with Disabilities Education Act 1990 (IDEA) (Kaufman, 2002). Section 504 and the ADSA require schools to provide aids and services to ensure that children will be medically safe while having the same access to educational opportunities as other

children. The IDEA funds special education services for children whose hypoglycaemic or hyperglycaemic episodes may impair significantly their ability to concentrate and learn. In order to support compliance with these laws, the ADA (2008) and the American Association of Diabetes Educators (AADE) (American Association of Diabetes Educators, 2012) issued position statements with guidelines for drafting medical care plans for children with diabetes.

Despite the presence of these laws and guidelines, wide variation was noted across the various states in the support offered to children with T1DM (Kaufman, 2002). In principle, schools in the USA are guided by medical position statements and guidelines for the drafting of effective diabetic medical care plans. However, in reality, schools in different states may perhaps be driven by financial factors rather than by legal obligations. They may have a legal obligation to provide medical care plans, but in reality those plans may only reflect the diabetic care that they can afford to support financially each year. This may not extend to the hiring of permanent medical personnel or to the regular training of all teachers in diabetes care related issues. At the same time, the implementation of these laws does demonstrate a clear commitment by the USA to oblige schools in the USA legally to provide support for children with diabetes, which can be contrasted with the lack of such laws in other countries.

In Minnesota, Hayes-Bohn *et al.* (2004) conducted qualitative research to study opinions, concerns, and recommendations regarding the care of children with T1DM in schools. The study used individual semi-structured interviews on a sample of thirty adolescent females and their parents. The participants' responses were audiorecorded, transcribed, coded for qualitative analysis, and were categorised as: (1) knowledge/training of school personnel; (2) foods offered/available at school; and (3) school rules (Hayes-Bohn *et al.*, 2004). Participants reported that they were most concerned that school personnel, particularly classroom teachers, possessed inadequate knowledge of diabetes (Hayes-Bohn *et al.*, 2004). Participants also reported that junk food was too easily accessible.

They wished for healthy alternatives and worried about a lack of availability of healthy foods and beverages in the cafeteria and vending machines (Hayes-Bohn *et al.*, 2004). Some participants reported that teachers used sweets as a reward for

students, school rules sometimes interfered with the self-management of diabetes, and some teachers forbade all students from eating or drinking in class (Hayes-Bohn *et al.*, 2004). This study demonstrated that even schools in highly developed countries such as the USA encounter problems in terms of ensuring that teachers are trained and knowledgeable in the treatment of children with diabetes.

Moreover, it also showed that children with diabetes still encounter practical obstacles to more effective self-management of diabetes within the classroom setting. Nevertheless it should be noted that there are two limitations affecting the quality of this study. The first is that the study was published over 10 years ago and significant developments have been made in the treatment of children with diabetes within the school setting, as well as an increased focus on children's healthy eating in schools. The second is that subjective qualitative analysis of 30 participant interviews limits the external generalizability of the study findings to other schools in the USA.

Hellems and Clarke (2007) anonymously surveyed parents of children with T1DM who were receiving their diabetes care at diabetes clinics situated at the University of Virginia. In contrast to Hayes-Bohn *et al.* (2004), the sample in this study consisted of 185 parents of children with diabetes enrolled in 153 different public schools in Virginia. The survey questions asked which school personnel were responsible for their child's diabetes care while at school, and which persons helped with specific care tasks including blood glucose monitoring, insulin administration and assistance with treatment of hypoglycaemia (Hellems and Clarke, 2007). Some 69% of participants reported that a full-time school nurse was assigned to their child's school, while 31% of participants reported that other school personnel such as teachers, administrators, coaches, and cafeteria workers supported part-time nurses in assisting students with diabetes management tasks (Hellems and Clarke, 2007).

Additionally, 75% of students experienced an average of five episodes of hypoglycaemia per year, but only one severe event requiring the use of glucagon was reported (Hellems and Clarke, 2007). Glucagon was administered appropriately by a part-time school nurse, and the student experienced no adverse effects of the treatment. It was concluded that legislation permitting non-medical school personnel to assist students with their diabetes management could make children's school days safer, and improve their overall glucose control (Hellems and Clarke, 2007). In

theory, the diverse sample of children with diabetes across 153 schools lends significant support to the need to facilitate non-medical assistance by school teachers or other school personnel for children with diabetes. However, potential issues relating to legal liability and legal duty of care still remain, if non-medically trained personnel are to assist children with diabetes, especially in relation to severe hypoglycaemic events.

In 2008, Jacquez *et al.* investigated parents' experiences of receiving support for their children during school in Florida (Jacquez *et al.* 2008). Parents were asked to express their concerns about diabetes management in school, and their knowledge of laws that protect children with diabetes. Differences in ethnic and socioeconomic status were also considered. Jacquez *et al.* (2008) found that: (1) many children (49%) did not have a written care plan or a nurse at school; (2) 54% of children could perform a blood glucose test in the classroom; and (3) 50% were allowed to administer it in special places. Significantly more white children (78%) had a written care plan or nurses to support diabetes management, as compared with Hispanic (48%) or black children (54%).

Black parents were more likely to report that their children were denied access to extra snacks and bathrooms than white or Hispanic parents. Most parents were worried about hyperglycaemia and hypoglycaemia in school, and most were not confident in the school personnel's ability to care for diabetes. High-income and white parents were more likely to be aware of federal laws compared to Black or Hispanic parents with low-income status (Jacquez *et al.*, 2008). This evidence serves as a reminder to researchers to consider carefully the make-up of populations in studies, even on a specialist diagnostic group.

Schwartz *et al.* (2010) surveyed 80 children and adolescents with diabetes, their parents or guardians, and school personnel who cared for children and adolescents with diabetes. Only 20% of the school nurses surveyed felt that they were adequately trained to assist students with hypoglycaemia (Schwartz *et al.*, 2010). Moreover 65% of school personnel reported they were concerned with liability issues that could be associated with improperly caring for students with diabetes (Schwartz *et al.*, 2010). This highlights the potential need to correctly balance practical issues relating to non-medically trained school personnel, and school policies regarding the provision of support for children with diabetes in schools. Indeed, 31% of participants said that

their schools had no existing policies in place to address the needs of children with diabetes, while another 21.6% were not aware of specific policies (Schwartz *et al.*, 2010).

Many parents or guardians (53.6%) felt that school personnel were supportive when their child missed days from school, 26.8% felt that they were usually supportive, 12.2% sometimes supportive, and 7.3% not supportive at all (Schwartz *et al.*, 2010). Some child participants (31.2%) reported that they were sometimes treated differently at school, while 22% reported that this was rare for them (Schwartz *et al.*, 2010). Children reported that they were accused of using diabetes as an excuse very often (14.6%), often (6.2%), or sometimes (16.7%). Feelings of embarrassment were also expressed by the children when experiencing diabetic related issues, such as hypoglycaemia (22.9%), or having to take medication or have their blood glucose check at school (27.7%) (Schwartz *et al.*, 2010).

### **Research in Spain**

Amillategui *et al.* (2007) surveyed 499 parents of school children with T1DM to identify the special needs of children with T1DM in schools, the difficulties experienced with full integration of the child into school, and to define interventions which might improve the situation. Survey questions addressed the following aspects: (1) children's integration; (2) blood glucose monitoring; (3) insulin administration; (4) meals; (5) sports; (6) school trips; and (7) attitudes of teachers and school personnel to the condition (Amillategui *et al.*, 2007). Only 34% of parents believed that teachers could recognise the symptoms of hypoglycaemia; 17% of parents experienced problems at their schools when they informed the authorities about their child's condition; 5% were not accepted; and 8% were forced to change school (Amillategui *et al.*, 2007).

It was also found that 9% had to modify glucose monitoring and 16% had to modify treatment because of lack of cooperation from the school (Amillategui *et al.*, 2007). It was concluded that training sessions on T1DM, an increase in the number of nurses, better availability of resources from the national diabetic association, and improved communication between school personnel and parents were factors that might improve the full integration of children with diabetes within the school (Amillategui *et al.*, 2007). This initial survey was followed up later by Amillategui *et al.* (2009) who surveyed 430 children with diabetes, their parents and teachers.



Teachers stated that they learned about a child with T1DM in their class from the parents of the child (87%), by previous teachers at the school (42%), or by the children themselves (28%) (Amillategui *et al.*, 2009). Parents (20%) and children (26%) reported that there had been one or more hypoglycaemic episodes before or during an exam. However, 92% of teachers said they had not observed any such episodes. Further difficulties arose when a significant level (46-51%) of responses stated that there was no glucagon available in school, with 10% of teachers admitting they did not know what it was used for, and 65% of teachers not knowing if there was somebody on the school staff capable of administering it (Amillategui *et al.*, 2009).

Regarding teachers' concerns, most worried about the possibility of a child going into a coma at school, or that the teachers would not be able to recognise a hypoglycaemic episode (Amillategui *et al.*, 2009). Moreover, teachers seemed particularly concerned over the likelihood of children with diabetes feeling marginalised. Most teachers (89%) felt that peers at school were sympathetic to children with T1DM, though only 81% of children and 71% of parents believed this to be the case (Amillategui *et al.*, 2009). Although the results of these surveys in Spain are not conclusive, each survey generally supports the other and each survey was based on relatively large sample frames, which increase the overall quality of the findings. What the studies clearly show is that there existed a definite need to increase the overall knowledge and education of teachers and other school personnel regarding diabetes issues in schools, as well as ensuring that more information about children with diabetes and treatments is available in schools in Spain.

### **Research in Italy**

Pinelli *et al.* (2011) conducted a two-phase study to understand the perceptions of children with T1DM and their parents and school teachers. The first phase was qualitative, consisting of parental focus groups (8-10 parents of children aged 6-13), and a children's focus group (4 children aged 6-13) (Pinelli *et al.*, 2011). Issues that arose from these focus group discussions involved the difficulty of children returning to school after being diagnosed with diabetes; individuals experiencing feelings of anger and sadness; individuals needing to feel calm and reassured; and individuals requiring privacy (Pinelli *et al.*, 2011).

In the second phase, questionnaires were administered to 220 parents and 52 school teachers. Most of the parents (88.9%) reported that diabetes had not influenced their choice of school, and 43.6% of parents cited other problems with their child, such as difficulty in concentration, difficulties with meals, and decreased enthusiasm, motivation, and school performance (Pinelli *et al.*, 2011).

This would seem to suggest that the difficulties that children with diabetes face in managing diabetes at schools, may affect children in physical, emotional, and behavioural ways. But the study showed that parents were not willing to talk about these problems to teachers in case these issues were interpreted as excuses for their child's performance. Consequently, this may mean that supporting children with diabetes in Italian schools effectively may require more than just physical support, in terms of the availability of diabetic supplies and facilities. It may also require greater teacher education and support in terms of teacher diabetic knowledge, guidance, support, and encouragement. The position in Italy where no support legislation exists for children with diabetes in schools can be contrasted directly with the position in the USA, where such legislation does exist, and provides for greater integration of children with diabetes requirements into the school framework.

The study showed 46.8% of children did not take insulin at school, 25.5% administered insulin autonomously, 20% administered with the help of a parent or relative, 3.6% were administered by a nurse, and 2.7% administered by a teacher (1.4% not disclosed) (Pinelli *et al.*, 2011). Most parents (63.6%) reported that their children had had at least one hypoglycaemic event during school hours, which school staff had dealt with safely by checking blood glucose, giving carbohydrates, or contacting parents (Pinelli *et al.*, 2011). A significant number (40.9%) of participants reported that schools had a refrigerator to store glucagon (Pinelli *et al.*, 2011).

However, only 23% of teachers considered their schools to be adequately equipped to manage an emergency, and in an emergency their first response would be to call an ambulance (Pinelli *et al.*, 2011). During academic and extra-curricular activities, 51% of teachers reported that the school took special precautions, such as allowing the child's parents to attend (Pinelli *et al.*, 2011). One of the difficulties that Italian schools face is that there is no National Care Programme which addresses children with diabetes in schools, although guidelines to administer medical treatment at

school exist (SWEET, 2009). So in principle it is difficult to make the case that Italian schools are neglecting their duties to children with diabetes, given that no clear legal obligation exists in practice.

### **Research in the United Kingdom**

Wilson and Beskine (2007) surveyed 73 children with diabetes and their parents, with 44 participants using insulin pump therapy and 29 administering multiple insulin injections daily. The questionnaire was designed to address areas of concerns identified previously in a pilot study of 20 parents. These included the diabetes care plan for children in schools; awareness of the plan; the use of pump therapy in the school setting; testing blood glucose at school; injecting insulin at school; and administering insulin pump boluses at school (Wilson and Beskine, 2007). All of the participants took blood glucose tests during school hours, one-third of these occurred in the classroom and over a quarter on elsewhere on school premises (Wilson and Beskine, 2007).

Blood glucose levels for children under 5 years old were tested by an adult, with approximately one third of children (aged 5–11 years) being self-testing, and all of the teenagers (12-16 years) being self-testing (Wilson and Beskine, 2007). Many parents felt unable to manage their child's diabetes once the child was at school, and a number of participants or their parents indicated there was no school diabetes care plan at their school (n=22); school staff did not check the blood glucose reading of the child (n=53); and school staff did not oversee the insulin injection (n=23) (Wilson and Beskine, 2007). Several parents (n=27) believed that pump therapy interfered with their child's education/situation at school, and most parents (n=27) expressed dissatisfaction with their school's provisions to support diabetes (Wilson and Beskine, 2007).

Newbould *et al.* (2007) conducted semi-structured interviews with 26 children with diabetes and their parents regarding their perspectives about managing their diabetes in the school setting. All young people with diabetes took items related to their condition to school, which included blood glucose monitoring equipment, insulin injections, blood testing strips, sugary carbonated drinks, glucose tablets and food items. Three respondents administered insulin at school, and all respondents reported problems with the lack of a private location within the school to administer

injections (Newbould *et al.*, 2007). Two young people reported administering injections in the toilet, which they described as cramped and unsatisfactory, and most participants reported food-related problems, such as not being allowed to eat snacks and the timing of school lunches, which made it difficult to regularly and effectively control blood glucose levels (Newbould *et al.*, 2007)

The respondents described school staff as being unsympathetic to the condition and needs of children with diabetes, or even disbelieving of their symptoms or difficulties, and 7 young people described relying on "informed friends" when in difficult situations (Newbould *et al.*, 2007). Participating in school trips presented additional problems and anxieties, as some schools were reported to have limited policies in relation to taking medication on schools trips. Furthermore, three young people expressed a feeling of being different from their peers due to their condition; and one reported being bullied and teased (Newbould *et al.*, 2007). Five parents were unhappy that school policies meant that behaviours encouraged within the home to ensure good diabetic control, such as regular snacking and monitoring blood glucose levels throughout the day, could not be continued in school (Newbould *et al.*, 2007).

Diabetes UK surveys (2009 and 2010, cited in Matyka, 2010) examined the provision of diabetes care in primary and secondary schools in the UK by contacting Local Education Authorities and schools. Fourteen percent of primary schools responded, amounting to nearly 3000 schools (Diabetes UK, 2009, cited in Matyka, 2010). In schools with children with diabetes, almost 50% had no policies to either supervise or perform blood glucose testing, 41% had no policy for staff to supervise medication, and 60% had no policy to administer insulin injections (Diabetes UK, 2009, cited in Matyka, 2010). If children were unable to inject insulin themselves, 70% of schools expected a parent to come to give the injection (Diabetes UK, 2009, cited in Matyka, 2010). A survey of secondary schools in 2009 (Diabetes UK, 2010, cited in Matyka, 2010) found that in schools with children with diabetes, 79% had health care plans involving the student, school and health care professionals. Almost all schools had a private area for insulin administration. However, only half had provided training for staff within the previous 12 months (Diabetes UK, 2010, cited in Matyka, 2010).

The results of the studies by Wilson and Beskine (2007) and Newbould *et al.* (2007) identified several key areas which inhibited effective diabetes treatment in schools for children with diabetes. Although it should be noted that the overall quality of these studies might be called into question, given the smaller sized samples of children used. However, the results of much larger surveys by Diabetes UK (2009; 2010, cited in Matyka, 2010) support the earlier findings. Consequently, although the UK is a developed country there would still seem to be problems and obstacles which many children with diabetes and their parent face in schools. Many of the problems highlighted by the studies, such as lack of insulin administration policies, staff education and training for children with diabetes, and dietary issues, have also been similarly highlighted in other countries.

Kime (2013) conducted a longitudinal (3 year) multi-site qualitative study on 116 children and young people from four age groups (taken from 9 NHS trusts in the Yorkshire and the Humber regions) and 141 parents. The study found that children in primary schools had a more positive experience than young people in secondary schools (Kime, 2013). However, it was also noted that many of the school staff were unfamiliar with T1DM, and had little knowledge of children's needs (Kime, 2013). It was also found that parents felt that most of the on-going education and care was left to them, and they emphasised the need for consistency in terms of policies and practices within schools and colleges (Kime, 2013).

In particular, parents expected policies to be put in place by schools relating to classroom management, storage of insulin and medical kits, and a safe place for students with diabetes to take their insulin (Kime, 2013). Lack of psychological support was another concern, as most children and young people felt isolated from their peers, and considered it would be beneficial for them to talk to others of the same age with T1DM (Kime, 2013). This study provides strong evidence to support the need for a more coordinated national response in the UK regarding the formulation of consistent diabetes support policies in schools.

### **Research in Taiwan**

A study by Lin *et al.* (2008) involved 12 semi-structured interviews with mothers of children aged 7-9 years with T1DM. The authors explored the experiences of these

participants in helping their children to make life adjustments at school with T1DM. The interviews were audio-recorded and transcribed verbatim. Narrative data were analysed using Colaizzi's six-step methodological approach. Three children in the study injected insulin themselves, whereas nine children required assistance or were totally dependent on the parent to give the injection.

The reported themes were: (1) concern over their child's safety (shortage of teachers, lack of care, physical safety, and child's life adjustment at school); (2) developing self-management skills in their children; (3) helping them to build peer relationships (observing the child's interactions with peers and assisting with group-life adjustment); (4) creating a safe environment for them (mothers' active involvement in school care and setting up a school-care network); and (5) improving their academic performance, and wanting to normalise their children's lives (letting go and encouraging the child's independence). The study was important because it identified the presence of various dynamic relationships between T1DM symptoms, the children's development, and collaborative self-care. This showed that if children are supported within a collaborative framework in the school setting, they are more likely to quickly develop self-management skills for T1DM.

### **Research in Australia**

Marks *et al.* (2014) surveyed 66 parents (91% mothers) of children with T1DM attending primary schools (Kindergarten, Year 1 or 2) in Australia. The purpose of this cross-sectional, descriptive study was to examine parents' perceptions of school management of diabetic students. The study focused on the types of diabetes treatment being delivered, who was providing the treatment, and where the treatment was being administered. All participants reported that their children received blood glucose testing at school, and 49% of them self-tested (Marks *et al.*, 2014). The majority of children (77%) received an insulin injection or pump bolus at school. The study found that the majority of children who used insulin pump therapy would receive insulin at school, compared to 55% of children using insulin injections (Marks *et al.*, 2014). It was also found that children who could self-administer were more likely to receive insulin at school (93%), compared to those who needed assistance (65%) (Marks *et al.*, 2014).

The children in school who self-administered insulin used insulin pumps more (38%) than injections (23%) (Marks *et al.*, 2014). Teacher's aides and teachers also administered insulin more using insulin pumps (26% teacher's aide, 30% teacher) compared to injections (6% teacher's aide, 12% teacher) (Marks *et al.*, 2014). The majority (81%) of children received insulin in the classroom, and the remainder (19%) in the school administration office (Marks *et al.*, 2014). Most (92%) blood glucose testing was carried out in the classroom (Marks *et al.*, 2014). Parents of children using insulin injections at school were questioned about insulin storage. Most parents (58%) stored insulin in the classroom, some stored it in the office (18%), some both areas (12%), and some did not store insulin at school (12%) (Marks *et al.*, 2014).

There were small disparities based on geographical location reported, with children living in small and large metropolitan areas more likely (83%) to receive insulin compared to those living in rural (67%) and semi-rural (71%) areas (Marks *et al.*, 2014). The study supports the increased use of insulin pump therapy in the classroom as delivering a better diabetes treatment regime for children. Furthermore, the study also indicated that there may be discrepancies in insulin therapy effectiveness in schools depending on the geographical location of children, so that children (and parents) in less developed areas might potentially benefit from increased information and knowledge about diabetes use and therapies.

## **School Systems**

In the USA, three federal laws protect the rights of children to obtain the care that they need while in school: Section 504 of the Rehabilitation Act of 1973 (Section 504), the Americans with Disabilities Act, and the Individuals with Disabilities Education Act (IDEA). Section 504 and the Americans with Disabilities Act require schools to provide aids and services to ensure that children will be medically safe while having the same access to educational opportunities as other children (Jacquez *et al.*, 2008).

The Americans with Disabilities Act calls for not only school nurses but for all school and day-care personnel involved with children with diabetes to have adequate training and understanding of general and emergency diabetes care. The most recent guidelines for diabetes management stated that at least one adult should be available for all diabetes management needs if a school nurse is unavailable.

However, in Ohio, it was found that many school systems had only a single nurse working across multiple schools (Schwartz *et al.*, 2010). In Miami it was found that 45% of schools had no nurse and that 24% of schools were unable to meet the needs of children with diabetes. The situation was much better in the Commonwealth of Virginia where separate legislation had been passed in 1999 requiring non-medical school personnel to assist students with the management of T1DM when school nurses were unavailable. Sixty-nine percent of the schools had a full-time nurse, 20% had part-time nurses with health clinic assistants to take over when the nurses were absent. Additionally, responsibility for diabetes care was also shared by the teachers, administrative staff, secretaries, cafeteria staff, gym teachers and bus drivers who had been trained. However, 9% of schools had no-one responsible for diabetes care.

In the UK, the Department for Education (2015) 'Supporting pupils at school with medical conditions' guidelines suggest that schools should make arrangements for disabled children including those with medical needs at different levels of school life. However, it puts the onus on local authorities, schools and governing bodies to work out their own policies based on statutory responsibilities and their own assessment of local needs and resources. In practice, previous guidance adopting a similar approach has translated into extremely variable care (Matyka, 2010). In the UK, Kime found that the majority of school staff were unfamiliar with T1DM. Diabetes specialist nurses would attend school when a child was newly diagnosed to agree a care plan, but most of the ongoing education and care was left to parents and relied heavily on the goodwill of a school volunteer to help them (Kime, 2013).

In Italy, legislation in 2005 asserted the rights of children with chronic diseases to an education and recommended that schools develop the infrastructure (rooms, personnel, etc.) for medication to be taken on school premises. Schools were encouraged to have a trained member of staff who was both able to assist with tasks related to the care of children with diabetes and other conditions and willing to take on responsibility. If no staff member was available, then the regional health service was to be approached to provide an assistant nurse to be available at specified times. However, it was rare to find personnel such as a nurse (3.6%) or a teacher (2.7%) who administered insulin treatment, with children or parents mostly left to fend for themselves (Pinelli *et al.*, 2011).



Amillategui *et al.* (2007) while studying 320 schools in Madrid, Spain found that 17% had both a psychologist and a nurse, 44% only a psychologist and 5% only a nurse available for the children. Psychologists were present in 46% and 40% of public or semi-public schools, respectively, but in only 14% of private schools. Nurses were present in 36% of public schools, 38% of semi-public schools and 24% of private schools. For 95% of children, teachers were aware of diabetes in the children in their care, but only 78% of physical education instructors were aware of the children's condition (Amillategui *et al.*, 2007).

In a study from New South Wales, Australia, parents reported that insulin at school was delivered by the child approximately one third of the time with the remaining two-thirds of delivery spread evenly across teachers, parents and teacher's aides. For children in kindergarten, school staff provided most (58%) of the blood glucose testing (Marks *et al.*, 2014).

In Taiwan, there was no school system in place. Parents were involved in all aspects of management of their children's diabetes via a collaborative network involving teachers, physical education instructors and peers (Lin *et al.*, 2008).

### **Support for Diabetes Management and School Rules**

Several studies have documented problems commonly experienced by children and adolescents with diabetes and their parents with regard to glucose monitoring, administering insulin, eating snacks when required, and restroom privileges. School personnel are unaware of how to recognize and manage complications such as hypoglycaemia and the school cafeteria has limited choices for diabetic children.

In a qualitative study by Hayes-Bohn from Minnesota USA on perceptions of adolescents with T1DM, it was found that even nurses were unaware of medication for diabetes. One adolescent was worried that the teacher would not know what to do if he fainted. However, 6 students praised the school staff for their professionalism. They reported that the nurses took the initiative to educate the other school staff and acted as advocates for the children. One praised a swimming coach who would recognize that she was getting hypoglycaemic and act promptly. Several adolescents and parents mentioned that food choices in the school cafeteria conducive to healthy diabetes management were limited (Hayes-Bohn *et al.*, 2004).

This was also reported by Schwartz *et al.* from Ohio, with 55% of parents saying that the nutritional information needed to calculate lunchtime insulin boluses at school was never available. More than half (53.2%) of children and adolescents in this study reported having been prevented from self-management of their diabetes or from using the bathroom at school. Only 41.5% of parents responded that their child was always afforded adequate time for self-care. Most parents reported being worried about their child having high (92%) or low (93%) blood glucose levels at school (Schwartz *et al.*, 2010).

In Miami Florida, only 49% of parents reported that schools had a glucagon kit available to deal with hypoglycaemic coma. Most children were not allowed to check blood glucose level (52%) or administer insulin (79%) in class. Only 46% of parents reported that insulin injections were allowed in special places at school (other than the classroom), with just 50% reporting that blood glucose checks were allowed in special places (Jacquez *et al.*, 2008).

In Virginia where a separate law was enacted for management of children with T1DM in the school, 69% of parents reported that a full-time school nurse was assigned to their child's school. In other schools, teachers, administrators, coaches, and cafeteria workers supplemented part-time nurses in assisting students with diabetes management tasks. Although hypoglycaemia was not a rare event (75% of students experienced a median of five episodes per year), only one severe event requiring the use of glucagon was reported. In that case, glucagon was administered appropriately by a part-time school nurse, and the student experienced no adverse effects related to the treatment. This shows that children with diabetes can be cared for safely in the school environment by nurses and other non-medical personnel.

In the UK, Kime (2013) reported that the quality of care varied particularly between primary and secondary schools. Children in primary schools had a more positive experience than young people in secondary schools. The young people attending secondary school stated most of the school staff did not know how to deal with them with regard to T1DM. Teachers complained when children asked to be allowed to have extra snacks or drinks or be allowed to use the toilet. There was no consistent policy or practice within schools relating to classroom management, the storage of insulin and medical kits and the provision of a safe place for children and young

people to take their insulin (Kime, 2013). The experience was similar in London schools (Newbould *et al.*, 2007). Matyka reported on the Diabetes UK survey which studied diabetes care in primary schools in the UK by contacting local education authorities and schools. Almost 50% had no policies to supervise or perform blood glucose monitoring. Forty-one percent had no policy for staff to supervise giving medication, and 60% had no policy to carry out insulin injections. If children were unable to inject insulin, 70% of schools expected a parent to come and give the injection (Matyka, 2010).

Amillategui reported that 75% per cent of Spanish parents stated that their children, (of whom 87% were in the 3 to 6-year-old age group), required glucose monitoring during the school day. In 26% of the cases, insulin had to be administered during the school day, but only 63% of the children were able to do this by themselves. In 16% of cases, treatment modifications were made because of a lack of cooperation from the school. In the event of a hypoglycaemic episode, only 34% of parents believed that school personnel would be able to recognize a mild episode. In 64% of cases, the children themselves had been able to resolve such an event, with the greatest proportion (80%) being in the 14 years and older age group. Only 9.8% of children had experienced a serious hypoglycaemic episode at school, but, according to parents, 55% of schools did not have glucagon available (Amillategui *et al.*, 2007).

Children in Italy were found either to self-administer insulin or to have help from a parent, since there was very rarely a nurse present (3.6%) or a teacher who would take responsibility for the treatment (2.9%). Most parents (55.9%) stated that the school had no fridge to store glucagon. Only 40.4% of teachers said that they had received any specific training for management of children with T1DM (Pinelli, 2011).

Marks *et al.* (2014), in a survey of Australian schools, found that children living in rural (67%) or semi-rural areas (71%) were less likely to receive insulin at school than children residing in larger metropolitan areas (83%). Again those using a pump for insulin delivery were more likely to receive insulin in school (Marks *et al.*, 2014). This was also reported in the UK (Wilson and Beskine, 2007). In Taiwan, with no formal school system, mothers were actively involved in creation of a collaborative network with teachers and peers to help in the management of the condition as well as to help integration of their child in school (Lin *et al.*, 2008).

## **Discrimination in the School**

In the UK, 23% of children and adolescents reported feeling embarrassed at school after experiencing hypoglycaemia or other diabetes-related incidents requiring intervention. However only 16.7% of the children and adolescents reported wanting to quit school or not participating in a school activity because of diabetes (Schwartz *et al.*, 2010). Young people expressed a feeling of “being different” from their peers due to their condition; while one child reporting bullying or teasing (Newbould *et al.*, 2007).

In Spain, 17% of parents experienced negative reactions from their schools when they informed them about their children’s disease. A proportion of these parents felt that they were victims of discrimination in that their child was not accepted into a school (5%) or was forced to find another, more cooperative, school (8%) (Amillategui *et al.*, 2007). Children returning to school after a diagnosis of diabetes reported feeling angry and sad and also felt a need for calm, reassurance, and privacy. At the middle school stage, children experienced embarrassment and had a strong need for privacy (Pinelli *et al.*, 2011).

In Taiwan, mothers used these occasions as opportunities to educate their children’s peers and enlist their cooperation and support in the management of the condition (Lin, 2008).

## **SUMMARY**

School systems varied widely across different countries, with some countries mandating support for children with T1DM through legislation, some through guidelines, and some providing neither. Support for children with T1DM varied, with some school systems having designated nurses and trained school personnel. The need for training and sensitization of school personnel regarding support in the management of T1DM was universally present. Support was especially needed for children in primary school who were dependent on parents or school personnel (nurses and teachers) for blood glucose testing and insulin administration. Programmes for increasing awareness in administrators and peers are also needed for better integration of children into school life and preventing discrimination.

## **KNOWLEDGE AND ATTITUDES OF SCHOOL PERSONNEL TOWARDS CHILDREN WITH T1DM**

This section discusses studies pertaining to T1DM. Eleven studies were identified which addressed the knowledge, attitudes or practices of various school personnel regarding their role in the management of T1DM in the school setting (Table 4). Most of the studies used a questionnaire format. Boden *et al.* (2012) employed a qualitative approach with in-depth, semi-structured, face-to-face interviews. Most of the studies were from the USA with a single study from the KSA.

Reports were reviewed with regard to knowledge and attitudes of school personnel about T1DM, especially with regards to issues such as recognising the symptoms and appropriate responses of hypoglycaemia and hyperglycaemia; blood glucose monitoring; insulin administration; attitudes and concerns of teachers regarding children with T1DM; whether any special precautions were taken prior to exercise and on school trips; and whether facilities were available to store insulin and glucagon in schools. Despite the varying research methodologies adopted, all studies were included so as to gain a comprehensive picture.

**Table 4: Studies of the knowledge and attitudes of school personnel towards T1DM**

Author	Objective	Type of study	Country	Outcome
Bradbury and Smith (1983)	To assess teachers' knowledge of T1DM and learn about the resources they used to obtain information.	Survey questionnaire on 97 school teachers	UK	25% of teachers had adequate knowledge of diabetes and existing literature was the main source of information.
Lindsay <i>et al.</i> (1987)	To determine the level of knowledge of diabetes among Salt Lake City school teachers.	Survey questionnaire on 475 school teachers	USA	26% felt that training in diabetes was inadequate.
Gormanous <i>et al.</i> (2002)	To determine the level of knowledge of diabetes among Arkansas public elementary school teachers.	Survey questionnaire on 463 school teachers	USA	Teachers were poorly informed about diabetes.
Alnasir (2003)	To assess teachers' knowledge of presentation and complication of diabetes mellitus among school children.	Self-administered questionnaire on 1140 school teachers	Bahrain	School teachers had inadequate knowledge about diabetes and its treatment.
Gawwad (2008)	To assess diabetes-related knowledge, attitudes and management practices among school teachers.	Self-administered questionnaire on 177 school teachers	KSA	Most school teachers had only fair diabetes knowledge and unfavourable attitudes.
Nabors <i>et al.</i> (2005)	To examine the teachers' knowledge of chronic medical conditions, and the teachers' confidence in meeting the academic and social needs of children with 13 illnesses.	Knowledge rating surveys on 247 school teachers	USA	Only 22.1% of teachers possessed adequate knowledge of diabetes, and 43% of teachers felt confident in helping pupils to meet other academic and social needs.

Author	Objective	Type of study	Country	Outcome
Shuff (2011)	To assess teachers' knowledge of diabetes and its symptoms.	Demographic sheet and eight-item questionnaire on 70 elementary school teachers	USA	All the teachers could identify the symptoms of diabetes correctly.
Tahirović and Toromanović (2011)	To assess whether the conditions exist in their schools to give adequate assistance to children with T1DM who are suffering from hypoglycaemia.	Cross-sectional survey on 74 school teachers	Bosnia and Herzegovina	Only 4% of teachers reported that their school had a written plan, and only 4% said drinks or snacks were made available in the school for children with T1DM.
Aycan <i>et al.</i> (2012)	To assess the knowledge and attitudes of school teachers on diabetes.	Survey questionnaire on 1054 school teachers	Turkey	Teachers had only limited knowledge and unfavourable attitudes on management of childhood diabetes.
Boden <i>et al.</i> (2012)	To explore the attitudes of primary school personnel on managing children with diabetes.	In-depth semi-structured face-to-face interviews on 22 school staff holding a variety of positions in primary schools	UK	The school personnel expressed several fears and worries about caring for diabetic students.
Tannous <i>et al.</i> (2012)	To investigate the knowledge and attitudes of Jordanian school counsellors towards diabetes.	Questionnaire on 295 school counsellors	Jordan	Moderate knowledge of diabetes held by student counsellor and favourable attitudes towards students with diabetes.

## Research Studies in the UK

Bradbury and Smith (1983) surveyed 97 teachers (class teachers and head teachers) who taught 60 diabetic students in Liverpool schools (18 children attended one of 13 primary schools and 42 children attended one of 27 secondary schools). The study sought to assess teachers' knowledge of T1DM and to learn about the resources that they used to obtain information. The questionnaire covered questions relating to the teachers' knowledge and attitudes to children with diabetes, sources of diabetes information, and diabetes in the school environment (Table 5). The level of knowledge was adequate for 24 teachers only. The majority of participants (n=56) stated that they were acquainted with children with diabetes who did not attend their school, and some teachers (n=22) reported being anxious about children with diabetes in their class.

Some teachers (n=11) felt uneasy about the possibility of acute diabetic illness arising in school, although teachers with more experience ( $\geq 20$  years) were significantly less likely to express anxiety than less experienced teachers. It is likely the case that the teachers with greater experience felt more competent to deal with diabetic issues that might arise. However, this finding relates to attitudes to diabetes and not to increased knowledge of diabetes. A range of information sources relating to acquiring diabetes knowledge was suggested, such as the diabetes literature (n=67), in-service courses or talks (n=18), or health professional visits (n=16). The study was highly significant because not only was it the first British study on the knowledge and attitudes of teachers to children with diabetes, but it also exposed the significant deficiency in knowledge and understanding of teachers of both basic and complicated diabetic issues (Bradbury and Smith, 1983).

Boden *et al.* (2012) explored the attitudes of 22 primary school staff members in relation to managing children with diabetes, using semi-structured face-to-face interviews. Topics such as knowledge of diabetes, relationships with parents and hospital diabetes teams, strategies for managing diabetes in primary school and possible methods for improving support for teachers were discussed in the interviews. The staff members expressed several fears and worries in relation to, or in anticipation of, caring for children with diabetes who were regarded as being "risky" pupils. This study was significant because it demonstrated the clear shift from



informal responses to health matters within schools, to the increased formalisation of risk management in schools.

**Table 5: Diabetes Factual Knowledge Questions and Number of Teachers Giving Correct Answer\* (Bradbury and Smith 1983, p.694)**

<b>Question</b>	<b>No.</b>
1. In untreated diabetes is the blood sugar level high or low? ( <i>high</i> )	62
2. Does insulin cause the blood sugar level to rise or fall? ( <i>fall</i> )	60
3. Is insulin given by tablets or injection? ( <i>injection</i> )	66
4. In an insulin reaction or 'hypo' is the blood sugar level high or low? ( <i>low</i> )	51
5. In an insulin reaction or 'hypo' does the diabetic child need insulin or sugar? ( <i>sugar</i> )	50
6. Should a diabetic child take any precautions before scheduled physical activity such as games or swimming? ( <i>yes</i> )	44
7. If a diabetic child develops thirst, vomiting, and stomach pain is his blood sugar level likely to be low or high? ( <i>high</i> )	39
8. Do you think this situation can be coped with in school? ( <i>no</i> )	41
9. If a diabetic child develops dizziness, sweating, and confusion is his blood sugar level likely to be low or high? ( <i>low</i> )	53
10. Do you think this situation can be coped with in school? ( <i>yes</i> )	53
11. Is it necessary for a special meal to be provided for a diabetic child staying for school lunch? ( <i>no</i> )	29
12. Is it necessary for a diabetic to weigh his food? ( <i>no</i> )	30
13. Is it reasonable for a diabetic child to miss or be late for a meal? ( <i>no</i> )	72
14. Is it necessary for a diabetic child to have a mid-morning snack? ( <i>yes</i> )	74
15. Should you ever allow a diabetic child to eat sweets in class? ( <i>yes</i> )	52
16. If detention were practised in your school would it be an appropriate punishment for a diabetic child? ( <i>no</i> )	48

<b>Question</b>	<b>No.</b>
17 Should the diabetic child be able to go on school outings or holidays? (yes)	91
18 If the diabetic child is ill in school should he be either left on his own or sent home on his own? (no)	91

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\* Correct answer in parenthesis. Ninety seven teachers responded.

Boden *et al.* (2012) showed that teachers felt more professionally accountable than previously for their actions and responses to health matters, but that this raised their concerns about issues such as injecting insulin, blood testing, and parents' reactions to teachers' decisions. The study also highlighted continuing discrepancies between instructions given by external parties (such as first aid trainers) to teachers, and practical daily healthcare routines for children in schools. This is because teachers were being advised not to take part in healthcare routines which might potentially expose them to legal action, but in practice this went against the support that teachers believed should be given to children with diabetes in schools (Boden *et al.*, 2012).

### **Research Studies in the USA**

Lindsay *et al.* (1987) conducted a study in Salt Lake City to determine teachers' strengths and weaknesses regarding knowledge of diabetes, recognising and responding to symptoms, and communicating with parents using a 32-point questionnaire. A total of 475 teachers were surveyed. Only 54% of the total group knew that diabetes was caused by a lack of insulin, and only 23% knew that children with diabetes required insulin injections for treatment. The study showed that there was some confusion among teachers relating to the treatment of children with diabetes in schools, as 21% of teachers believed that diabetes could be treated with pills alone; 35% believed that a diet alone was sufficient; and only 55% recognised signs of low blood glucose such as sleepiness, pallor, and sweating. Lindsay *et al.* (1987) concluded that a typical elementary school teacher demonstrated inadequate knowledge of many aspects of diabetes, such as how to recognise and treat acute diabetic crises and misunderstandings of causes of diabetes. The study supported the findings of Bradbury and Smith (1983) and highlighted the need for increased

teacher training. Indeed, 74% of teachers expressed that their training was insufficient (Lindsay *et al.*, 1987). Since both studies are now rather dated, it is possible that the situation has changed since then. However, the evidence to this effect is limited.

Gormanous *et al.* (2002) sought to determine the level of knowledge of diabetes among public elementary school teachers in Arkansas. A total of 463 teachers were selected randomly from 27 elementary schools in 35 counties to complete a survey. Most of the teachers were able to identify the symptoms of diabetes, but a majority (62%) did not know which type of diabetes needed lifelong insulin, and only 65% of teachers could identify the symptoms of hypoglycaemia. Only 37% could identify the correct treatment. There were significant limitations to this study since only 7% of participants actually had a child with diabetes in their classes, and issues of diabetes care practices in the school were not addressed.

Furthermore, despite the random selection of schools, the findings have limited external validity because the study did not reflect a population which was ethnically diverse and also excluded male perspectives. It is notable that 79% of the teachers were interested in receiving diabetes educational materials which showed that the teachers were amenable to developing increased knowledge of diabetes management (Gormanous *et al.*, 2002). The study highlights one of the difficulties in obtaining reliable data which is representative of a more diverse general population.

This can be seen in a survey carried out by Shuff (2011) of 11 elementary schools in Virginia, where 83% of 135 elementary school teacher respondents were female, and only 12 males responded. A questionnaire was administered to the 135 teachers with survey questions pertaining to knowledge about diabetes and its symptoms. Of the 70 teachers who responded, 34% had received some training in diabetes in the past, all of them could correctly identify the symptoms of diabetes, and 49% could state the normal range for blood glucose. However, only 14 % of participants could state the causes of hypoglycaemia, and only 11% knew the correct treatment of hypoglycaemia (Shuff, 2011). Although this study supports the findings of Gormanous *et al.* (2002), it nevertheless suffers from the same limitations.

Nabors *et al.* (2005) developed a survey to examine teachers' knowledge of chronic medical conditions, and their confidence in meeting the academic and social needs of children with diabetes. Thirteen illnesses that were prevalent in schools in a mid-western city were addressed in the survey, which included diabetes, asthma, epilepsy, chronic allergies, HIV, and sickle cell disease. The sample consisted of 247 teachers from 15 elementary schools who were asked to self-rate their knowledge and confidence levels for children with each of the 13 illnesses based on a 6-point Likert scale that ranged from "not at all knowledgeable/confident" to "very knowledgeable/confident." Most participants were not well informed about any of the conditions. Teachers showed low levels of being very well informed about diabetes (22.1%) compared to knowledge about asthma (34.2%). On the other hand, a larger number of teachers were very confident in meeting diabetic students' academic needs (42.5%) and social needs (43.7%).

There are two significant limitations of this study. The first is that it is possible that teachers' knowledge of diabetes could be even lower than reported. This is because teachers may have believed their knowledge of diabetes to be much higher than was actually the case when self-rating. In these types of self-reported survey it would seem to be more useful to include surveys that include questions on factual knowledge of diabetes, which can demonstrate the participant's actual knowledge, rather than potentially arbitrary self-rating techniques. There was also no procedure put in place to randomly test the reliability of the self-rating by the teachers, for example by using follow-up face-to-face questioning, or testing of a sample of the teachers.

### **Research Study in Bahrain**

Alnasir (2003) distributed a pre-designed self-administered questionnaire to 1248 male and female teachers from 49 schools randomly selected out of a total of 152 schools in Bahrain. However, survey questions addressed only signs and symptoms of diabetes (both Type 1 and Type 2) and did not deal with attitudes or practices in the school. There were a total of 1140 responses, albeit only 1064 teachers responded to the knowledge part of the questionnaire. From the results of this part of the questionnaire, it was found that female teachers had better knowledge levels (89.5%) compared to male teachers (76.6%).

It was found that science teachers had similar diabetic knowledge (89.6%) to arts teachers (83.6%). It was seen that teachers with an unsatisfactory perception about general health had only slightly more diabetic knowledge (92%) than those teachers with unsatisfactory views (84%). The score ranged from 0 (low) to 10 (high) and the study showed a mean knowledge score of 5.34 (SD=2.13), which led to the conclusion that teachers had inadequate knowledge of the basic facts of diabetes and its treatment (Alnasir, 2003). This study is useful in demonstrating the existing knowledge levels of both male and female teachers across all schools in Bahrain, as the literature in this area is rather sparse.

### **Research Study in the KSA**

Gawwad (2008) distributed 177 questionnaires to school teachers in 11 public primary and intermediate schools, and randomly selected participants from the middle educational district in Riyadh City. The purpose of this study was to assess diabetes-related knowledge, attitudes and management practices among school teachers in order to determine their diabetes-training needs and readiness. The questionnaire was comprised of 60 true-false items regarding the nature of diabetes and its pathophysiology, significance of blood glucose levels, signs and symptoms of hypoglycaemia and hyperglycaemia, diabetic diet, and basic management and control.

Teachers' attitudes toward diabetes management and education at school were measured using 10 statements with responses based on a 3-point Likert scale. This was intended to elicit their attitudes toward diabetic students. It was found that the majority of participants (78%) had fair total knowledge of diabetes in children, and many participants (58.8%) had fair total management of diabetes scores. However, it was also found that many participants (56%) had unfavourable total attitude scores toward diabetes management and education, and many (64.4%) also believed that providing diabetes care to students was not their responsibility, but a family responsibility (Gawwad, 2008).

Given that a very limited 3-point Likert scale (as opposed to a 7-point Likert scale) was used, the accuracy of the findings can be questioned. However, notwithstanding this limitation the research study is useful not only for demonstrating low levels of diabetes knowledge in Saudi teachers, but for highlighting potential areas for future

study. For example, the study found a significant negative relationship between diabetes knowledge and attitude scores (Gawwad, 2008). This might be a cultural issue or factor which could be investigated in greater depth. Few teachers expressed confidence in their own abilities to manage diabetes (6.8%), and yet only a small number of teachers wanted to attend further training about diabetes care (9%) (Gawwad, 2008). This can be distinctly contrasted with the findings by Gormanous *et al.* (2002), where 79% of teachers were interested in further training.

It may be the case that Saudi teachers view these types of health issues as not within the scope of their teacher responsibilities, and are therefore against spending more time learning about diabetes. The mean age of the teachers was  $34.4 \pm 11.3$  years, and the majority were Saudis (91.5%), married (81.4%), and University educated (89.3%) (Gawwad, 2008). This would tend to suggest that the teachers are intelligent, educated, and experienced individuals who rationalise and justify the viewpoints that they adopt. If the majority are against seeking further diabetes training and see diabetes care as the responsibility of the family, it will possibly require specific intervention programmes, or official school or government diabetes policies, to impact and/or change these existing negative viewpoints.

### **Research Study in Bosnia and Herzegovina**

Tahirović and Toromanović (2011) surveyed 74 teachers from 35 schools to assess whether conditions in their schools were adequate to give assistance to children with T1DM suffering from hypoglycaemia. Most of the teachers knew what hypoglycaemia was, but only 4% said there was a written plan for children with diabetes. Fifty-one percent of teachers replied that children were allowed to measure their blood glucose during class, and 73% indicated that children with diabetes were allowed to have a drink or snack during lesson time. However, only 4% of participants said drinks or snacks were made available in the school for children with diabetes, and only 5% reported that there was a staff member who knew how to administer glucagon in the event of hypoglycaemia.

This study showed worrying results, because 49% of teachers did not allow children with diabetes to measure their blood glucose levels during class, and 27% did not allow children with diabetes to eat or drink during classes. If children have low blood glucose levels in class, are not allowed to measure their blood glucose level, and

cannot eat or drink, they may potentially suffer an episode of hypoglycaemia for which most teachers will not have an emergency plan. Out of a total 74 positive responses, 30 teachers cited lack of attention paid to problems of children with T1DM, and 30 teachers cited lack of education of teaching staff (Tahirović and Toromanović, 2011). Education of teaching staff is therefore vital in order to ensure that such schools can provide a safe environment for children with T1DM.

### **Research Study in Jordan**

Tannous *et al.* (2012) surveyed 295 counsellors working in both public and private schools in Amman for: (1) demographic information; (2) counsellors' attitudes toward diabetes using a 22 item 6-point Likert scale; and (3) knowledge of types of diabetes; (4) symptoms; (5) insulin-handling; (6) diet; and (7) precautions when dealing with diabetes. Counsellors demonstrated a moderate level of knowledge overall about diabetes, in terms of epidemiology and medical knowledge (Mean=0.66 out of 1.00). The counsellors showed the highest mean knowledge ratings for knowledge of food portions consumed (M=0.95), symptoms of diabetes (M=0.93), quantity of food intake (M=0.92), protection and hygiene (M=0.92), and practicing sports (M=0.91). Although Jordan and the KSA are both Middle Eastern countries, there is a clear distinction to be made between the lower diabetes knowledge levels in Saudi teachers as compared to counsellors in Jordanian schools. This study provides evidence that there may potentially be a significant correlation between knowledge and attitudes.

In this study the highest mean attitudes ratings were associated with the way people think of diabetes as not being a disability (M=5.12); the right to have a family life and not to be scrutinised just for being diabetic (M=4.94); and the need for further knowledge about diabetes and the way of dealing with it (M=4.84) (Tannous *et al.*, 2012). Unlike Saudi teachers in the study by Gawwad (2008), the results also showed counsellors had favourable attitudes toward students with diabetes, and this may impact on overall knowledge levels. Indeed, the lowest mean knowledge ratings were associated with more complicated diabetic knowledge, such as the level of saturated fat in nuts and cereals (M=0.38); diabetes medications (M=0.28); activities for diabetics (M=0.26); and the difference between T1DM and T2DM (M=0.25) (Tannous *et al.*, 2012).

## **Research Study in Turkey**

Aycan *et al.* (2012) administered a questionnaire to 1054 primary and secondary school teachers from three regions of Ankara, in order to assess their knowledge and attitudes towards diabetes. It was found that 94% of teachers were able to give a correct definition of diabetes, and 47.6% had a moderate general knowledge of diabetes (Aycan *et al.*, 2012). It was also found that 59% of teachers were aware that blood glucose levels might decrease in children with T1DM, and that if this happened 56.1% would administer sugar-added products, and 20.1% would administer a chocolate bar or candy to the child (Aycan *et al.*, 2012). The study found that school teachers in Ankara had limited knowledge on diabetes overall. There are two interesting aspects pertaining to this study. The first relates to the sociodemographic characteristics of the teachers. The mean age of the teachers was  $38.8 \pm 8$ , 79% had been educated to University level, 45.3% of the teachers had a family history of diabetes, and most had significant professional experience (11-15 years (45%), 16-20 years (16%), >20 years (11%)) (Aycan *et al.*, 2012).

Despite most of the teachers being older, highly educated, and with many years of professional experience, they were still not able to demonstrate good working levels of diabetes management knowledge. This is despite the fact that many of them had a family history of diabetes which in theory should have made them more aware of the underlying issues. The second aspect relates to the finding that 52.8% of teachers had no children with diabetes attending their classes, so there exists a possibility that teachers' knowledge of diabetes may be correlated with children with diabetes being actually present in a class - teachers see no need to act to improve knowledge with no children with diabetes present. Still, it should be noted that Turkey's Diabetes Programme in School which was launched in 2010 has been making significant progress, as by the end of 2011, over 7.5 million students, and nearly 600,000 teachers were trained in 25,000 schools by a range of diabetes healthcare experts (Hatun and Özcan, 2013).

## **Knowledge of School Personnel regarding T1DM**

Studies were reviewed with regard to knowledge of school personnel about T1DM, especially with regards to issues such as recognising the symptoms and appropriate



responses to hypoglycaemia and hyperglycaemia; blood glucose monitoring and insulin administration.

In 1983, Bradbury and Smith (1983) from the UK found that the knowledge of diabetes in children amongst school teachers was very limited. Only 24 teachers (25%) seemed to have adequate understanding of diabetes, and there was little knowledge of recognition and treatment of emergency diabetic problems or aspects of diet. Most information had been obtained from either diabetic pupils or their parents and not from medical or nursing personnel. In 2012, the situation was marginally better with teachers still very unsure of how to recognize and manage hypoglycaemia and not being comfortable with giving injections (Boden *et al.*, 2012).

Lindsay *et al* in the USA found that only 54% of teachers could correctly name the symptoms of diabetes, only 23% knew that insulin was required for treatment, and 21% and 35% respectively felt that oral medication or diet alone were adequate to treat diabetes in children. Only 55% could correctly identify the symptoms of hypoglycaemia, 22% said they would take the child to the cafeteria whereas 30% said they would call the mother in such an event (Lindsay *et al.*, 1987). Gourmanous *et al.* (2002) found that this had not improved much 15 years later with 62% of school teachers not knowing which type of diabetes required insulin and 50% unable to diagnose hypoglycaemia. Of equal concern was that 25% were unaware of the presence of a diabetic child in their class. Inadequate knowledge in school teachers about diabetes in children was also reported by Schuff (2011).

Comparably poor knowledge in school teachers of children with diabetes in Bahrain was reported by Alnasir (2003), while inability in school teachers to recognize and respond to hypoglycaemia was also found in Bosnia and Herzegovina (Tahirovic and Toromanovec, 2011).

American school nurses interviewed by Nabors *et al.*, on the other hand, were found to be particularly pro-active, with 92% having a written diabetes plan for children with T1DM under their care. They felt that school teachers and other school staff such as physical education instructors should be encouraged to improve their knowledge about diabetes since nurses were not available during after-school activities. They also felt that adolescents should have better support in school, with designated places for testing and injection and better food choices in the cafeteria. They also felt

that parental involvement in the management should be encouraged (Nabors *et al.*, 2005). No obvious reason for the conflict with other study results could be identified.

In Jordan, the responsibility for managing care for children with chronic health conditions, including diabetes, rests with school counsellors and teachers. Despite training programmes for counselling being present, these programmes did not contain any elements related to diabetes in children. There were clear deficits in counsellors' and teachers' knowledge especially that related to diet and the medications needed to treat the condition. Many were not aware of the differences between T1DM and T2DM. Most of the knowledge had been obtained from the media or from parents (Tannous *et al.*, 2012).

### **Attitudes of School Personnel toward Children with T1DM**

Bradbury and Smith (1983) reported that 22 of 97 teachers admitted anxiety about having children with diabetes in their class. Eleven were uneasy about the possibility of acute illness while in school, and some expressed uncertainty about their ability to cope should such a situation arise. Two indicated that they would be worried only if they knew that the child's diabetic control was unstable. Two were concerned about the possibility of academic failure, and two physical education teachers mentioned the possible effects of exercise.

In the KSA, most teachers felt that diabetic students deserve special attention (64.4%), but 37.9% felt that students with diabetes pretend to be ill to win their teacher's sympathy. Moreover, 64.4% felt that providing diabetes care to a student was not their responsibility but a family responsibility. Surprisingly, those with better knowledge about the disease seemed to have more negative attitudes towards children with diabetes. Few teachers expressed confidence in their own abilities to manage diabetes (6.8%), and yet only a small number of teachers wanted to attend further training about diabetes care (9%) (Gawwad, 2008).

The attitudes of school counsellors in Jordan toward students with diabetes were generally positive and may reflect their willingness or preparedness to have a role in supporting these students in school (Tannous *et al.*, 2012).

In Turkey, a study of school administrators, teachers and physical education instructors found that 10.1% would be unwilling to have a child with diabetes in their class, 5.9% said they would accept a child with diabetes but under duress, and 24.3% felt that these children should not be allowed to participate in physical education. However, 76.5% declared that they would support children with diabetes in any way necessary (Aycan *et al.*, 2012).

Boden *et al.* (2012), studying perceptions of UK primary school teachers found that teachers had three main areas of concern. The first concern was about managing a child with diabetes: concerns about injecting insulin and testing blood, potential for children to mismanage their condition, and worry about the reaction of parents to teachers' health-related decisions. They were also apprehensive about the various expectations of teachers. They worried about their vulnerability and accountability, and were anxious about possible litigation. Yet most expressed their willingness to undergo training to enable them to take on the challenges involved in managing a child with T1DM (Boden *et al.*, 2012).

## **SUMMARY**

Research undertaken both in western and developing countries has demonstrated that knowledge amongst school personnel regarding T1DM is generally inadequate. Teachers expressed anxiety about having to manage a child with T1DM in their class and about legal liabilities. A lot of this stemmed from having inadequate information about the disease and not knowing how to recognise and respond to emergencies. Teachers in primary school were more involved in helping children with T1DM with blood glucose testing and insulin administration. Most teachers expressed the need for training to respond competently to children with T1DM in their care.

## **THE EFFECTIVENESS OF TEACHER HEALTH EDUCATION PROGRAMMES**

Education of teachers and school personnel is crucial in order to equip them with the appropriate information and skills needed to respond promptly and effectively to any incident relating to children with diabetes in schools. As can be seen from Table 6, varied intervention programmes or methods relating to diabetes education have been used around the world with a range of outcomes.

The CASP checklist for randomised controlled trials was applied to guide the analysis. All the studies addressed clearly focussed issues. Radjenovic and Wallace (2001) used a programme to impart information about T1DM in American school children. Teachers appear to have been assigned to one of two groups by random allocation (hard copy materials or web-based materials). However, the means of allocation is not stated explicitly in the study by Gesteland (1989). Teachers were drawn from the same school and evaluated 8-10 weeks later, so it is possible that there could have been communication between the two groups. Concealment was unclear in both studies. There is no indication of blinding of study personnel. Accordingly, the results must be treated with caution.

The other authors used pre-test post-test designs to gauge effectiveness of the intervention. There was considerable heterogeneity in the interventions used; ranging from dedicated programmes consisting of lectures, video, pamphlets and question-and-answer sessions to computer and web-based interventions. Those delivering the interventions also differed: from trained diabetes educators to trained knowledgeable parents. These factors necessarily affected the outcome and make comparison difficult.

The study by Vanelli *et al.* (1999) did not address the specific issue of the knowledge, attitudes or practices of school personnel on T1DM in children, but focussed rather on reducing the incidence of diabetic ketoacidosis in the Parma region of Italy through an extensive information programme over eight years. The study was included since it presents a novel and inexpensive way to impart information. Hatun *et al.* (2012) planned a Turkish programme including movies for education of school teachers in T1DM, but, while preliminary and intermediate results showed that teachers appreciated the programme and had learned much from it, the programme was still to be evaluated fully for its impact.

**Table 6: Effectiveness of school teacher diabetes health education programmes**

Author	Country	Intervention	Sample	Follow-up	Objective	Outcome
Gesteland (1989)	USA	Diabetes education using videotaped, written materials (pamphlets), question-answer session (45-50 minutes).	244 teachers	8-10 weeks	To evaluate the effectiveness of two delivery methods to administering diabetes education.	The authors found improvements in knowledge scores regarding diabetes treatment in participants (programme group) who received video presentations of the intervention.
Jarret <i>et al</i> (1993)	USA	Parents educated teachers on care of children with diabetes -1 session of 20-30 minutes.	49 families	6-8 weeks	To assess the effectiveness of a programme designed to teach parents how to instruct elementary school teachers about children with diabetes.	The research found a significant improvement in many aspects of the teacher's knowledge of diabetes, and refinement of the programme might yield increased knowledge.
Vanelli <i>et al.</i> (1999)	Italy	Combination of posters, diabetic professionals, toll free numbers, and postcards.	438,232 children in 177 school	Over a period of 8 years	To assess the effectiveness of an information programme regarding diabetes in children.	Results of a study on newly diagnosed children with T1DM eight years following the introduction of the information programme showed incidences of DKA decreased from 78% to 12.5% in ten years.
Siminerio and Koerbel (2000)	USA	Diabetes education programmes for school personnel (lecture style for 1 and 1.5 hours).	156 school personnel in six school districts	Immediate	To determine the baseline knowledge scores about diabetes, and to assess for significant differences in pre-test-post-test scores.	Overall, participants scored significantly higher on the post-test following the intervention.
Radjenovic and Wallace (2001)	USA	Diabetes training material via either paper (group1) or a web-based computer system (group 2).	42 school teachers randomized to 2 groups	Immediate	To assess the viability of a web-based technique for educating school personnel in diabetes.	A web-based (computer audio and video) diabetes training experience provided teachers with significantly higher knowledge and satisfaction than a paper-based scheme.

Author	Country	Intervention	Sample	Follow-up	Objective	Outcome
Gutierrez (2011)	USA	"Salus Education Diabetes Care at School: Bridging the Gap" online training programme.	192 staff members: unlicensed diabetes care assistants, and school nurses	Not applicable	To measure the knowledge of school personnel on diabetes basic information, diabetes management, and diabetes laws in Texas.	The results of pre-test post-test indicated significant increases in the knowledge and confidence scores of the participants following the online training programme.
Hatun (2012)	Turkey	Combination of posters, brochures, and programme guide for teachers on diabetes care for children and short film available online.	All primary and middle schools	Followed up with programme effectiveness evaluations	To develop a programme to raise T1DM awareness, strengthen diabetes care for children, and created healthy attitudes towards nutrition in Turkish schools.	Preliminary survey results showed that the online education platform and website had helped teachers to understand the symptoms of diabetes and led to increased awareness for early diagnosis. An initial follow-up survey, showed 85% of the surveyed teachers noted they were satisfied with the diabetes education; 89% noted the programme was informative about diabetes symptoms of diabetes. Another follow-up survey showed 99% of teachers found the website useful for retrieving relevant information.

## Interventions and Outcomes

Gesteland in the USA compared two interventions to improve the knowledge of elementary school teachers regarding T1DM in children. One group received pamphlets and were shown a video. This was followed by a question-and-answer session. The other group was informed that the same material was available in the media centre. Though there was a statistically significant improvement in knowledge, it was not clinically significant. It was concluded that mass education to elementary teachers was ineffective and that other approaches needed to be considered (Gesteland, 1989). It was suggested that the intervention would have been more effective if there had been students with T1DM in the teachers' classes during that period.

Traditional diabetes education for school personnel is site-constrained, time-constrained and costly. Education sessions must be held in a central location (hospital, clinic or school) with teachers having limited capability for travel to attend a presentation. The timing of a scheduled session may not correspond to when the instruction is urgently needed at diabetes diagnosis or at the beginning of the school year. With this in mind, Radjenovic and Wallace trialled two interventions: a computer-based training system about T1DM designed for school teachers for one group, and a paper-based American Diabetes Association publication for school personnel. The text content of both interventions was identical. The computer-based system was supplemented by a popular children's video about T1DM, audio-visual materials being available not automatically but on seeking. An open-ended time frame not exceeding 45 minutes was employed. The computer-based group was found to have higher scores than the paper-based group and had a higher satisfaction rating (Radjenovic and Wallace, 2001).

Jarett *et al.* trained motivated, knowledgeable parents to teach American elementary school teachers about T1DM as a study intervention. A significant improvement in knowledge was observed, but a few basic concepts remained unclear. It was felt that some refinement in the programme and repetition when students with T1DM were present in the classes might result in an effective diabetic education programme for elementary school teachers (Jarett *et al.*, 1993).

Gutierrez evaluated the 'SALUS Education Diabetes Care at School: Bridging the Gap' programme which ran over seven months<sup>1</sup> in Texas. It consisted of 3-6 hours of

training provided by certified diabetes educators for school nurses and unlicensed diabetes care assistants (UDCAs). A significant increase in knowledge and confidence in dealing with children with T1DM was found (Gutierrez, 2011).

Siminerio and Koerbel evaluated the effectiveness of a diabetes education programme called the 5 Cs (Causes, Classification, Complications, Care and Cure) Program. The school personnel who were trained included teachers and school nurses. A lecture format of 60-90 minutes followed by questions and answers was followed. The lectures were delivered by certified diabetic educators. School personnel in six school districts where the programme was implemented were evaluated before and after the intervention. The mean pre-test score was  $75 \pm 11.0$  which increased to a mean post-test score of  $94 \pm 4.1$  after the intervention, indicating an improvement in knowledge, though the longevity of the knowledge increase and its impact on behaviour was unknown.

## **SUMMARY**

Various interventions have been applied for increasing school personnel's knowledge of T1DM in children. Computer-based programmes have been applied in an attempt to deliver interventions using minimal resources and were been found to be effective. The lecture format by trained diabetes educators with an opportunity for the teachers to ask questions and clear their doubts seems to be the most effective intervention, suggesting that an interactive approach with opportunity to clarify personal uncertainty is superior to other methods.

## **GAPS IN KNOWLEDGE IDENTIFIED AND RATIONAL FOR THE STUDY**

It was clear that there was a persistent deficit in the knowledge and understanding of school teachers about management of T1DM. However, there were also some indications that teachers are often willing to learn and to take more responsibility. No single method of intervention was found to be entirely satisfactory. Intervention that involves interaction and the opportunity to clarify issues, discuss concerns and gain reassurance on a number of sources of anxiety was seen to be more likely to be effective. A combination of lectures, booklets and interactive learning showed promise. The justification for a focus on primary school teachers was reinforced since it was clear that younger children required more help with blood glucose testing,



insulin administration and decisions regarding their treatment, and also that they were generally not able to report signs of hypoglycaemia or hyperglycaemia, therefore being more reliant upon teachers during the school day.

## **CONCLUSION**

There is a clear deficit in empirical and high-quality research that focuses on school teachers' practices (especially knowledge and attitudes) regarding school children with T1DM. Despite the issue being investigated in depth as far back as 1983, the progress made after more than 30 years is certainly not significant or substantial. The evidence that has been provided by the literature is generally only of moderate quality and lacking in generalizability. Relatively few studies have been undertaken, and they have generally not been followed up with other studies to probe deeper into potential causal connections or correlations.

The literature has demonstrated that this problem is seen across many different countries, including Australia, Bahrain, Jordan, Spain, the KSA, the UK, the USA, and Turkey. What the research has also shown is that schools face many different practical challenges in providing adequate support for children with diabetes, and that this may often be the case because of negative attitudes towards children with diabetes. These types of challenge not only require time and effort, but are also costly, for example in terms of providing suitable facilities for blood glucose monitoring, insulin administration or training. The same might be said for diet and nutritional management for children with diabetes in schools, which also imply budgetary implications.

Nevertheless, in practice the potentially negative physical and psychological repercussions of bad or ineffective management of diabetes in schools means that these issues need to be specifically addressed. The literature has demonstrated a number of issues that are common across a range of different countries. These include lack of coordination provided at a national level, financial constraints, negative cultural attitudes, low levels of knowledge and awareness of teachers about diabetes, and lack of staff education programmes. In developed countries such as the UK and the USA, it has been seen that laws that provide care for children with diabetes in schools have improved the situation overall, yet difficulties remain.

In developing countries such as the KSA and Bosnia and Herzegovina, where the literature has shown that problems that children with diabetes face in schools are significant, there is a lack of reliable and representative research literature. Consequently, there is a distinct gap in the evidence base relating to issues surrounding the care of children with diabetes in schools. Yet, a brief survey of the results of diabetes interventions on teachers in schools shows that these types of intervention may sometimes be successful. The high incidence of diabetes present throughout the KSA, and especially in children, means that this issue is one that must be taken seriously by the Saudi government. From a policy perspective, the introduction of intensive diabetes treatment for children has placed increased demands on Saudi schools.

Availability of school nurses may often be limited, yet the literature has highlighted negative attitudes relating to teachers taking responsibility for children with diabetes in schools, as compared to family responsibility. Effective training interventions are a potential way to increase the knowledge and skills of school personnel to facilitate effective management of diabetes in the school setting. This literature review has demonstrated that further research into this area is not only needed, but would be highly beneficial for Saudi school children with diabetes. Understanding the problem in depth is the first and necessary step towards formulating effective solutions in the KSA.

## **CHAPTER 4**

### **STUDY DESIGN**

#### **INTRODUCTION**

The main purpose of this research study was to assess the impact of a specially designed health education programme on the knowledge and attitudes of primary school teachers towards T1DM in children from Jeddah City. The intent was to observe changes in the participants' knowledge and attitudes as a direct result of intervention in the form of the education programme. The experimental group was expected to exhibit statistically significant gains in knowledge and attitudes following the intervention (post-test 1) and over a six-month period (follow-up test), demonstrating the overall effectiveness of the health education programme. In contrast, the control group was expected to show no significant gains in knowledge or attitudes towards children with T1DM. The effects of socio-demographic factors (age group, gender, level of education) on pre-test scores and post-test scores were also investigated.

This research design was based on repeated measures (Lavrakas, 2008). In repeated measures, the same individuals are observed or tested at several points over a period of time on the same variable to measure change following an intervention (Dimitrov and Rumrill, 2003; Stommel and Willis, 2004). Post-tests were conducted at 3 months and 6 months in order to minimise the effects of the participants completing the self-administered questionnaire multiple times. These effects include prior recall, memory, knowledge, or experience affecting responses to questionnaire items (Bickman et al., 2010; Lavkaras, 2008; Gravetter & Forzano, 2012).

This chapter is a detailed account of the research aim, objectives, and hypotheses. It also includes discussion of issues relating to the study design, recruitment process and study population, sampling, data collection, instrumentation, data analysis, discussion of a range of limitations of the research study. This chapter ends with research ethics process.

## RESEARCH AIM, OBJECTIVES AND QUESTIONS

### Research Aim

The aim of this research was to measure the effectiveness of a specially designed intervention on the participants of an experimental group over a specified period of six months. A control group of participants not subject to the intervention was included in the research in order to test that any identified effects were caused by the intervention.

### Research Objectives

The research objectives incorporate the measurements of knowledge and attitudes of primary school teachers taken at pre-test (*baseline*), post-test (*3 months*), and post-test 2 (*6 months*) stages. In order to achieve the research aim the following research objectives were adopted:

- To establish pre-test, post-test, and post-test 2 measures for primary school teachers' knowledge and attitudes in the control groups and experimental groups.
- To administer the health education programme intervention to primary school teachers in the experimental group only for a period of nine weeks.
- To compare the pre-test, post-test, and post-test 2 measures of knowledge and attitudes scores of primary school teachers in the control groups and experimental groups.
- To observe any change in pre-test measures of knowledge and attitudes scores of primary school teachers in the control groups and experimental groups, compared to post-test measures three months after the health education programme intervention was administered.
- To observe any change in pre-test measures of knowledge and attitudes scores of primary school teachers in the control groups and experimental groups, compared to post-test 2 measures six months after the health education programme intervention was administered.

- To examine the impact of socio-demographic factors (gender, age group, level of education) on the pre-test scores of primary school teachers in the control groups and experimental groups, based on their responses in the demographic survey.
- To assess the impact of socio-demographic factors (gender, age group, level of education) on the post-test and post-test 2 scores of primary school teachers in the control groups and experimental groups based on their responses in the demographic survey.

### **Research Questions**

The following research questions were posed in order to facilitate achieving the study aim and objectives.

1. Is there a difference between control and experimental groups' knowledge about children with T1DM at the pre-test stage?
2. Is there a difference between control and experimental groups' attitudes towards children with T1DM at the pre-test stage?
3. Is there a difference between the experimental group's knowledge pre-test and post-test scores following the health education programme intervention?
4. Is there a difference in the control group's knowledge pre-test and post-test scores?
5. Is there a difference between the experimental group's attitude pre-test and post-test scores following the health education programme intervention?
6. Is there a difference in the control group's attitude pre-test and post-test scores?
7. Does primary school teachers' knowledge about children with T1DM change over time without receiving the health education programme intervention?

8. Does primary school teachers' knowledge about children with T1DM change over time following the health education programme intervention?
9. Do primary school teachers' attitudes towards children with T1DM change over time following the health education programme intervention?
10. Do primary school teachers' attitudes towards children with T1DM change over time without receiving the health education programme intervention?
11. What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' knowledge (experimental group) pre-test scores?
12. What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' attitude (experimental group) pre-test scores?
13. What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' knowledge (experimental group) post-test scores?
14. What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' attitude (experimental group) post-test scores?

## **RESEARCH STUDY APPROACH AND OVERVIEW OF THE STUDY DESIGN**

### **Theoretical Basis of Study**

The study design was based on the traditional scientific approach developed from philosophical traditions in the 16<sup>th</sup> and 17<sup>th</sup> centuries. This espouses a realist ontology – the belief that there is a reality which can be discovered through objective observation, measurement, and comparison if a sufficiently rigorous experiment is conducted. Key concepts of determinism – that all tangible things are governed by

pre-existing, stable rules, and scepticism - the belief that everything is open to challenge and revision are central to this ontology.

Epistemologically, the approach was based in empiricism – the principle that knowledge is gained through observation which is subject to objectivity and the removal of extraneous variables which introduce bias. A deductive stance is taken in which questions and hypotheses are stated in advance to be tested through observation.

Random sampling, manipulation and control of variables are the main features of the method, which features systematic and methodical collection of numerical data followed by statistical analysis. Experimental method is the gold standard, though practical limitations often require a quasi-experimental approach to be adopted.

## **Overview of the Study Design**

A study design can be defined as a specific plan or protocol utilised in order to achieve the objectives of the study (Creswell, 2008). In general, there are two types of experimental research design, a true experimental design and a quasi-experimental design (Gribbons and Herman, 1997).

### **True Experimental Research Design**

A study design can be defined as a specific plan or protocol utilised in order to achieve the objectives of the study (Creswell, 2008). In general, there are two types of experimental research design, a true experimental design and a quasi-experimental design (Gribbons and Herman, 1997). According to Crosby *et al.* (2006), true experimental designs are used so that causal inferences can be made with a high degree of certainty about the cause-effect relationship between the independent and dependent variables being studied. True experimental research designs are characterised by the manipulability of an independent variable (Crosby *et al.*, 2006), experimental control, and random assignment of participants to groups, all of which maximise the internal validity of the results (Henrichsen *et al.*, 1997; Sheskin, 2003). The optimal setting for a true experiment is a laboratory since control of extraneous variables is easier to achieve (Schoenfeld, 2006).

Manipulation refers to the treatment or intervention being changed purposely by the researcher to create treatment conditions, such as altering the environment, programme, or treatment (Brickman and Roy, 1998; Gravetter and Forzano, 2012). Experimental researchers exercise control by preventing outside factors (confounding or extraneous variables) influencing the outcome of the study (Brickman and Roy, 1998). When manipulation and control are utilised in an experiment and the study outcome occurs, then the researcher can claim with more confidence that the manipulated variable caused the outcome (Kidder and Judd, 1986; Cummings *et al.*, 2001).

Randomisation involves the assignment of participants by chance into one of two or more groups, by using a random numbers table, using software programmes, or other such rigorous techniques. This minimises any differences between groups by distributing subject characteristics equally (Cummings *et al.* 2001; Crosby *et al.*, 2006). Generally speaking, the participants receive a new treatment or intervention, no treatment or intervention, or an existing treatment or intervention (Brickman and Roy, 1998). The benefit of using random assignment is that the groups will differ only in the intervention programme or treatment to which they were assigned, so that any change that is observed during and after the course of the study can be solely attributed to the intervention programme or treatment (Kidder and Judd, 1986, Cummings *et al.*, 2001). This highly controlled and systematic procedure is used by experimental researchers to minimise error and bias, whilst also increasing their confidence about the causation of the outcome (Kidder and Judd, 1986; Cummings *et al.*, 2001).

This research study did not meet the full criteria for a true experimental research design, as several characteristics were missing. First, the health education programme intervention remained static and could not be manipulated or altered in any way. Second, the participants could not be assigned randomly to groups because of the likelihood of contamination within schools. Therefore, the groups were not equivalent at the onset of the study. Finally, although strenuous efforts were made to control extraneous variables that might influence the study outcome (Morgan, Gliner and Hamon, 2000), maximum control of the study was not achieved. The research study therefore used a quasi-experimental research design.



## **Quasi-Experimental Research Design**

Experimental research designs which cannot meet the requirements for a true experiment are termed quasi-experimental (Gribbons and Herman, 1997). According to Jackson (2012), quasi-experimental research designs have some of the features of true experimental designs but they may lack comparison or control groups (a single group design). They may also involve using a non-manipulated independent variable or using pre-existing or natural groups. Alternatively, random assignment of participants to groups may be impossible, impractical or unethical (Gribbons and Herman, 1997; Dimsdale and Kutner, 2004). However, attempts are made to minimise threats to internal validity (Morgan *et al.*, 2000; Gravetter and Forzano, 2012). The usual setting for quasi-experimental research is a natural one (Schoenfeld, 2006).

Participants are assigned either to receive an intervention (experimental group), or to receive no intervention (control group). In this study, primary school teachers from selected schools were assigned either to the experimental group to receive the health education programme intervention or to the control group to receive no intervention. Non-manipulated independent variables are also known as subject variables because they represent participants' characteristics that cannot be changed, such as age, gender, ethnicity or political affiliation (Gravetter and Forzano, 2012; Jackson, 2012). Research studies that are designed to assess the differences in people are by default quasi-experimental rather than a true experiment, because non-manipulated individual variables will be present (Jackson, 2012).

The non-manipulated independent variables in this study were teachers' knowledge of T1DM in children and teachers' attitudes towards children with T1DM. The participants' existing knowledge and attitudes were already established when they agreed to participate in the study. In addition, participants were not randomly assigned to groups. The researcher selected the schools that would participate in the study randomly from the five main parts in the city, but it was not possible to assign the primary school teachers employed at these different schools randomly into groups based on their existing knowledge and attitudes towards children with T1DM. It is likely that experimental group and control group teachers in the same school would compare notes (perhaps sometimes literally) and talk about the intervention, so control group participants might be affected unintentionally by the intervention.

## **Non-Equivalent Group Design**

A quasi-experiment does not meet all three components of an experiment (intervention, control, and randomisation), but it must have an intervention, as without an intervention there is no experiment. The researcher has to do something to produce an effect or outcome (Parahoo, 2006). Most quasi-experimental designs can be distinguished by the inclusion of one or two groups of participants and by single or multiple measurement points (Sheskin, 2003; Jackson, 2012). Quasi-experimental designs containing two groups are referred to as 'non-equivalent control group designs' (Sheskin, 2003; Jackson, 2012).

The non-equivalent groups design is an established and frequently used design in social research (Trochim, 2001). Reichardt (2005) elucidates further by stating that a non-equivalent group design is a quasi-experiment design that is used to assess the relative effects of treatments that have been allocated to participant groups in a non-random fashion. Control groups and experimental groups were included in this study. Whole schools rather than individuals were randomised.

## **Non-equivalent Control Group Pre-test-Post-test Design**

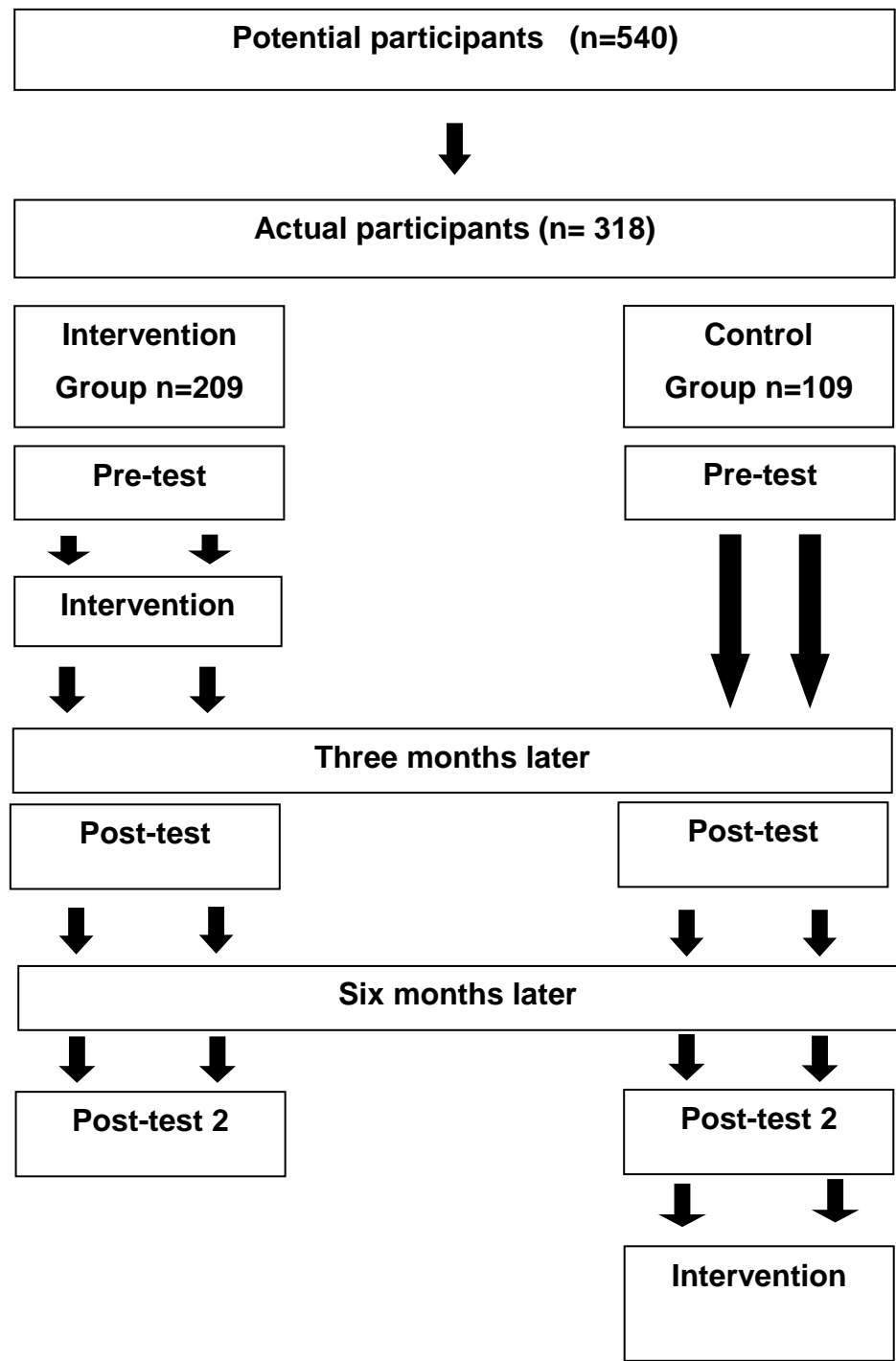
According to Gravetter and Forzano (2012), a non-equivalent control group pre-test-post-test design is used to compare two non-equivalent groups, where the experimental group is measured twice, before an intervention and then again after the intervention. The control group is measured at the same two points in time, but without the intervention. Any changes that occur in either group after the experimental group receives the intervention can be assessed by comparing the pre-test and post-test measures (Jackson, 2012). In addition, the researcher can address selection bias which is associated with all non-equivalent group research by comparing participants' scores before the intervention to determine the degree of equivalence of the two groups. If the groups are similar before treatment, the threat of selection bias is reduced, though not eliminated (Gravetter and Forzano, 2012). Pre-test-post-test research designs are most commonly used to assess the short-term effects of an intervention conducted within a limited timeframe, and are considered to be a special type of repeated measures design (Stommel and Willis, 2004).

## **Repeated Measures Design**

According to Lavrakas (2008), longitudinal research designs are another type of quasi-experimental design that includes repeated measures or time series. In repeated measures designs, the same individuals are observed or tested at several points over a period of time on the same variable (Stommel and Willis, 2004). This design is an expansion of the one-group pre-test-post-test design and is used to focus primarily on change, growth, and developmental types of research questions that concern learning, adaptation, physiological and psychological changes, health maintenance, maturation, or other kinds of time-related processes that occur within people (Stommel and Willis, 2004; Lavrakas, 2008).

Repeated measures designs are characterised by the timing and number of measurements. Generally, three or more observations are made, but the time period between taking measurements can vary from minutes to years depending on the nature of the variables. Therefore, a repeated measures design refers to both short-term and long-term follow-up of the same individuals over time (Stommel and Willis, 2004). Different terms have been used to describe the analysis of data obtained from repeatedly measuring the same individuals, including repeated measures design, within-subjects design, longitudinal data analysis, growth modelling, multilevel growth modelling, and individual change modelling (Salkind, 2007).

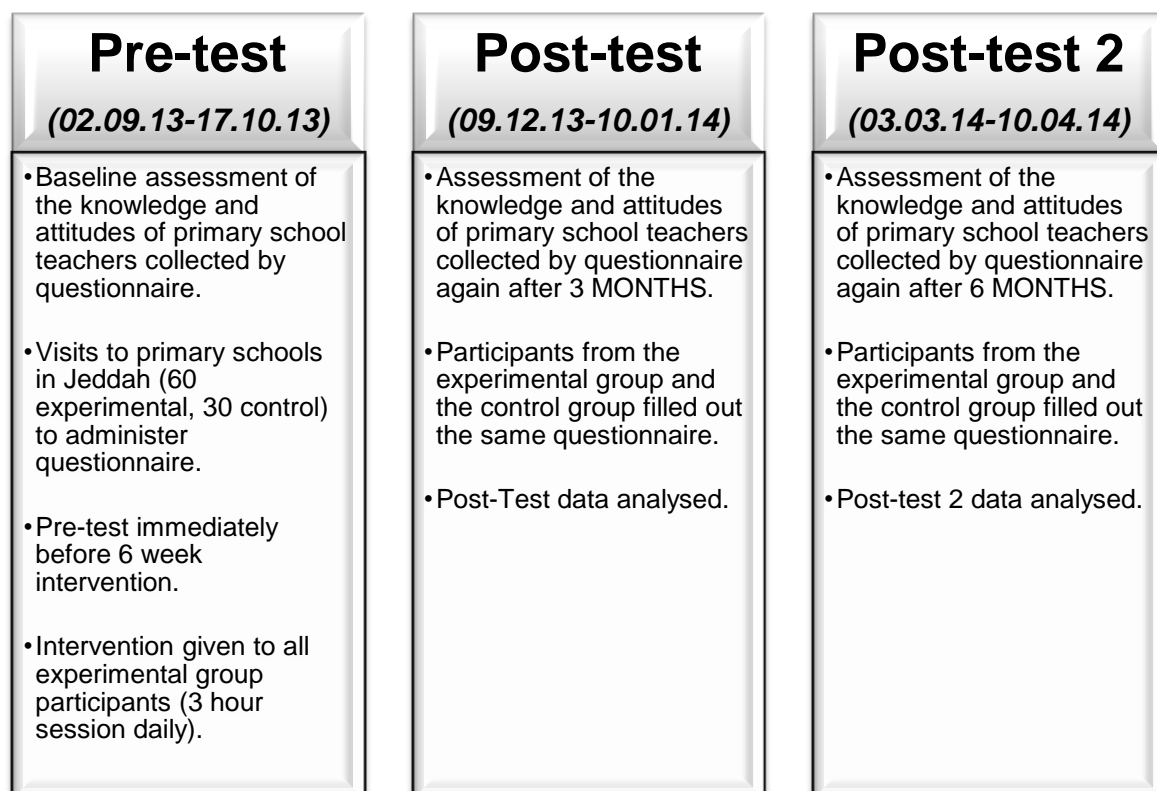
Figure 3: Research Study Process Diagram



## The Study Design

In this study, research participants were allocated either to the experimental group or to the control group by randomly selected schools. Knowledge and attitudes were assessed using a questionnaire before the intervention, and at two specific set points after the intervention (Figure 3). This type of research design is useful when seeking to measure the change after the intervention, and to test the cause and effect of relationships (Dimitrov and Rumrill, 2003). Measurement data was obtained at a pre-test (*baseline*) date (*September 2013*), and followed by measurement data obtained at post-test (*December 2013*) and post-test 2 (*March 2014*) dates (Figure 4). In practice this allowed for early and sustained changes to be identified. The importance of conducting pre-test and post-test analyses was to rule out the effects of natural maturation and testing as causes of any of the underlying changes detected (Crosby *et al.*, 2006; Gravetter and Forzano, 2012). Furthermore in order to increase overall reliability and minimise bias, statistical analysis of variance (ANOVA) techniques were adopted to compare pre-test scores and post-test scores.

**Figure 4: Non-equivalent groups repeated measures design**



## **POPULATIONS, SAMPLING AND RECRUITMENT**

### **Sampling**

Sampling is the process of selecting a portion of the study population for a research study (Heckathorn, 2002). A non-equivalent groups design means that participants are assigned to interventions in a non-random, non-quantitatively ordered manner (Reichardt and Mark, 2001). The key element of a non-equivalent groups design is that there is a lack of random assignment of group participants. Purposive sampling is also acceptable when random assignment is not an option (Singleton and Straits, 2005). The study adopted a non-equivalent groups design owing to non-random sampling of the research participants. The study participants were selected using a two-phase sampling process. In the first stage, a stratified random sampling technique was used to select the primary schools to be used as part of the study. Stratified random sampling means stratifying the population by a criterion and then selecting a random sample from each of the resulting strata (Bryman, 2012). The advantage of using a stratified random sampling technique is that it can ensure that the resulting sample is distributed in much the same way as the population according to the stratifying criterion (Bryman, 2012).

The geographical distribution of primary schools in Jeddah City is uneven, and consequently a stratified random sampling technique was used in order to increase the representativeness of the sample. This was done by allocating five strata, namely the North, South, Centre, East, and West regions of Jeddah City, with 20% of each sample taken from each strata region. This resulted in 90 primary schools out of a total of 683 primary schools located in Jeddah City being randomly selected for inclusion in the study. Out of the 90 primary schools, 60 schools were randomly selected to be included in the experimental group and 30 schools were randomly selected to be included in the control group (Appendix [1]).

In the second stage of the sampling process, purposive sampling technique was used to select research participants based on the study criteria established by the researcher. This non-scientific sampling method is appropriate when randomization is not possible and not all individuals within a target population have an equal chance of being chosen for participation in the study (Paler-Calmorin and Calmorin, 2007). The aim of purposive sampling was to focus on primary school teachers from both

public and private school sectors who taught one of six grades at primary schools, which ranged from grades 1 to 6. The head teachers of each school were asked to identify potential participants from each of the grades at each school based on the stated criteria. However, teachers with first degree relatives with T1DM, with a background in health care, or with recent training in the management of T1DM were excluded from the study, following the data collecting process, to minimise selection bias that might otherwise be introduced (Bowling, 2014).

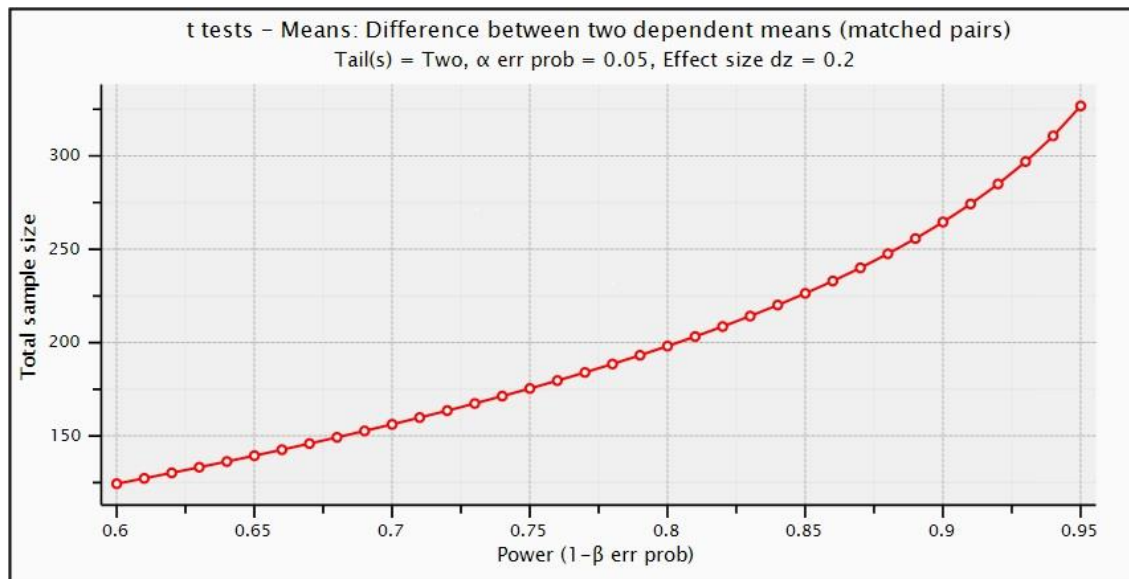
## **Power Analysis**

According to Lakens (2013), statistical power analyses are used to minimise the probability of committing Type 2 or beta errors, which imply falsely retaining an incorrect null hypotheses. There are three important elements needed to determine an appropriate sample size before conducting a study: (1) the alpha level (the significance criterion); (2) effect size (small = 0.20, medium = 0.50, and large = 0.8); and (3) statistical power (Cohen, 1988; Lakens, 2013). When these elements are known or can be approximated, the recommended sample size can be calculated. A power analysis carried out prior to the research study allows the researcher to determine the number of participants needed to detect a specific effect on the dependent variables being studied (Lakens, 2013).

Specially, G\*Power software, 3.1.0 version, was used to further determine an appropriate sample size for conducting paired samples t-tests when using .05 for the alpha level, .80 as the preferred statistical power, and .50 as the desired effect (Faul, Erdfelder, and Buchner, 2007). The results of this analysis indicated that a sample of at least 199 individuals was needed to achieve these elements, as shown in Figure 5. Another comparative analysis utilized with the G\*Power software yielded the recommended number for group sizes, which were as followed: Group 1 (experimental group) = 160 individuals and Group 2 (control group) = 40, based on the same criteria.

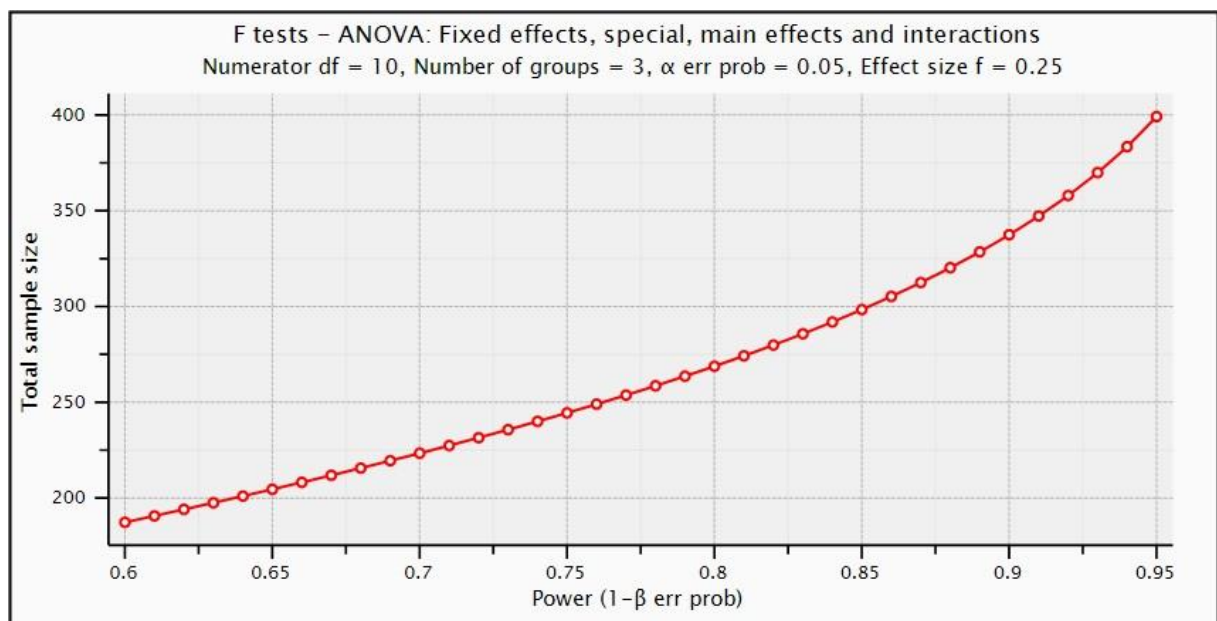
An effect size is a method used to quantify the difference between two groups. It is calculated by subtracting the mean of the control group from the mean of the experimental group, and then dividing the result by the standard deviation.

**Figure 5: Power analysis calculated by G\*Power**



The desired sample size in this study was calculated *a priori*, based on an alpha level of 0.05, small effect size of 0.25, and statistical power of 0.80. Using Cohen's guidelines (1988), the minimum sample size for analysis of variance was 100 to 120, for statistical power between 0.81 and 0.88, respectively. Again, G\*Power software was utilized to calculate the minimum sample size for the ANOVA tests, and the results indicated that a minimum of 269 individuals were needed to achieve the desired alpha, statistical power, and effect, as depicted in Figure 6.

**Figure 6: Sample size analysis for ANOVA calculated by G\*Power**





## **Target Population**

The population of Saudi Arabia is estimated to be approximately 28,376,355 million based on Central Department of Statistical Information held in the KSA (CDSI, 2013). For the purpose of a research study the target population is the entire accessible group of persons that is of interest to the researcher, or that meets the criteria the researcher is interested in studying, and to which the results will be generalised (Brink *et al.*, 2002). Jeddah City is home to 683 primary schools and approximately 20,100 primary school teachers (CDSI, 2013).

The target population was all primary school teachers located in Jeddah city, since there are distinct cultural and socioeconomic differences between regions of the KSA. For example, more nomadic and tribal cultures can be found in the provinces, while more modern and urban cultures tend to reside in the large cities of KSA. In practice, these cultural and socioeconomic factors may influence schooling practices in those distinct regions. Therefore, the study was confined to a single city region in order to restrict other confounding variables that might influence the focus of the study.

## **Study Population**

The study population is a sub-set of the target population defined by specific characteristics and which could, theoretically, be selected for the study (Kidder and Judd, 1986; Brickman and Roy, 1998). In this research study, the study population was all of the primary school teachers in Jeddah, and that formed the pool from which the sample was drawn. Participants were recruited from 90 primary schools that were randomly selected from each part of Jeddah City, and 20% of the sample was taken from each region (North, South, Centre, East, and West). This represented a sample of 13.177% of the study population. Participants in the experimental group were drawn from 60 schools, and participants in the control group were drawn from 30 schools. This more than satisfied the requirements for each group as calculated by G\*Power above.

## **Recruitment**

Recruitment of the teachers into the study followed gender distribution as required by Saudi Islamic law, namely male teachers at the boys' schools and female teachers at

the girls' schools. The recruitment process spanned a period of 9 weeks in order to reach primary school teachers at the 90 schools involved in this study. The total time spent on recruitment for the experimental group was 6 weeks (60 schools were covered with two schools visited per day (i.e. one male and one female school). The total time spent on recruitment for the control group was 3 weeks (30 schools were covered with two schools visited per day).

The most recent and up-to-date list of schools in Jeddah was provided by the Saudi Ministry of Education, which contained the location and contact details for all schools in Jeddah. The researcher contacted each of the head teachers in advance and explained the overall aims and objectives of the research study. At each grade level, for the experimental group, 20 teachers were recruited from public schools and 10 teachers from private schools. In the control group, 10 teachers were drawn from public schools and 5 teachers from private schools. A total of 540 participants were invited to participate in the study. The sampling frame is displayed in Table 7. While the control group may appear to be small, their purpose was only to ensure the required coverage across types of schools and year groups. Statistical analysis was undertaken on the larger groups of experimental and control groups.

**Table 7: Sampling Frame**

	<b>Experimental group = 60 schools</b>				<b>Control group = 30 schools</b>			
	<b>Boys Schools (n=30)</b>		<b>Girls Schools (n=30)</b>		<b>Boys Schools (n=15)</b>		<b>Girls Schools (n=15)</b>	
Teachers of	Public (n=20)	Private (n=10)	Public (n=20)	Private (n=10)	Public (n=10)	Private (n=5)	Public (n=10)	Private (n=5)
Grade 1	20	10	20	10	10	5	10	5
Grade 2	20	10	20	10	10	5	10	5
Grade 3	20	10	20	10	10	5	10	5
Grade 4	20	10	20	10	10	5	10	5
Grade 5	20	10	20	10	10	5	10	5
Grade 6	20	10	20	10	10	5	10	5
Sub-total	120	60	120	60	60	30	60	30
	<b>Total = 540 teachers</b>							

### **School Sessions**

The head teachers of each school then arranged a date to conduct the research and they also arranged a theatre or meeting room to facilitate the study. At each session,

six teachers from each school were in the arranged time and place. The researcher had previously prepared an envelope for each school with the name of the school written on it and six consent forms, six information sheets, six surveys, six booklets, and one CD for the educational video to be shown. Each participant had an individual research number assigned to them, and each questionnaire had a number to be followed for the same teachers in the following stages of the research. For the pre-test stage the full sample of research participants was tested (N=540), as all six invited teachers attended from each school. However, there was a drop in the overall number of teachers that participated at post-test (N=513) and post-test 2 (N=521). The head teachers informed the researcher that some participants had subsequently moved, or were on sick-leave.

## **THE INTERVENTION**

The International Diabetes Federation (2015) underpins the use of education programmes or interventions to increase awareness and support for children with diabetes in many facets of their lives. Special attention is given to the school environment since children with diabetes are likely to encounter teachers and other school personnel with inadequate knowledge of their condition. Based on the findings of their own research, the International Diabetes Federation reported that diabetes management plans in schools were generally ineffective due to lack of knowledge and to stigma, as well as discrepancies in school policies across the world. For diabetes management to be successful in school environments, the organization recommends the development of education programmes about T1DM that cover in more detail the warning signs, symptoms, and treatment of the conditions for school personnel. These principles support the rigour of the health education programme developed for this study, as it addressed diabetes issues that may arise in school settings, key diabetes issues, and involved interactive learning activities and open discussions.

Overall the intervention for this study consisted of administering the questionnaire to the experimental group and control group participants at the pre-test date; delivering the health education programme to the experimental group participants situated across 60 schools; administering the questionnaire to the experimental group and control group participants at the post-test date (3 months); administering the questionnaire to the experimental group and control group participants at the post-

test 2 date (6 months); and delivering the health education programme to the control group participants situated across 30 schools after the research study had been completed. This was good practice and fair for these participants. Since randomisation had prevented these teachers from benefiting from the intervention during the study, this measure corrected the temporary imbalance in benefits to participants.

### **Implementation of the Health Education Programme**

The health education programme spanned 9 weeks in total. The first 6 weeks consisted of providing the health education programme to the experimental group, with each experimental group participant being given an approximately three-hour health education programme session per day per school, on the school premises. The experimental group health education programme was spread across 60 schools, with 2 schools undertaken per day (1 male and 1 female school). The duration of the post-completion intervention for the control group was approximately 3 weeks and was spread across 30 schools, with 2 schools undertaken per day (1 male and 1 female school), i.e. 10 schools completed per 5 day in a school week. The researcher and the female diabetes educator attended the female schools in the experimental groups, though the diabetes educator conducted the intervention independently. This allowed the researcher to observe the conduct of the intervention and any potential sources of bias as well as to gain learning for future studies which may benefit from adjustment to the method.

### **The Content of the Health Education Programme**

The health education programme consisted of the research participants taking part in a range of different types of activities, including lectures, groups sessions, discussion, as well as being provided with follow-up reading materials. The health education programme was split up into 5 parts which are set out Table 8. The research team spent a total of between approximately 3 to 4 hours at each school setting up and delivering the health education programme. The details for each individual part of the health education programme which each participant took part in are set out separately.

**Table 8: Five Parts of the Health Education Programme**

Part	Title	Time	Overview	Procedure
1	Introduction	30 mins	Setting out aims of the study and filling in the questionnaire.	Personal introductions, clarification of the purpose and structure of the intervention, and establishing ground rules that ensured that the session would be participatory and collaborative, with a commitment to listening and encouraging. The participants also completed the questionnaire at this point.
2	Setting the scene	20 mins	Presentation of a scenario. Short discussion'	A scenario of a common diabetes issue arising in school in which the teacher becomes confused, worried and angry, with a poor immediate outcome for the child. This scenario was presented as a prompt in order to promote sharing among participants of common experiences, concerns, and hopes for learning from the health education programme.
3	Overview of the key issues in diabetes	60 mins	Overview of key issues (knowledge and attitudes) with an educational video about T1DM signs, symptoms, and treatment.	A learning phase in which key elements of knowledge and practices were presented in various formats, each included in a leaflet for participants to take away with them. It also included an educational video about T1DM signs, symptoms, and treatment, which was originally created by the non-profit organisation JDRF, but subsequently dubbed into the Arabic language. Topics covered: (1) an overview of T1DM in children; (2) diet and nutrition; (3) activity and exercise; (4) hyperglycaemia symptoms and treatment; (5) hypoglycaemia symptoms and treatments; (6) management of emergencies (first aid); (7) diabetes and school (including safe storage of the medication, container for the glucometer, and sweets for each diabetic child); (8) the importance of cooperation between parents, children, and the school and health care team; and (9) children with diabetes and stress in school.
4	Interactive learning	60 mins	Group work focused on improving responses to diabetic scenarios (interactive learning).	Scenarios relating to diabetic emergencies as well as example situations for individual and group discussion and participation. The symptoms, management and perceptions of T1DM in children featured strongly in these scenarios and situations. This part aimed to focus participants' attention on knowledge of T1DM, and to facilitate their self-awareness of their level of understanding of T1DM. It also aimed to promote confidence in the participants' ability to support children with diabetes effectively at school, with a view to enhancing life-long health and wellbeing of children with diabetes. Scenarios addressed: (1) the onset of DKA in the classroom; (2) a diabetes-related emergency; (3) a hypoglycaemic episode during physical education; (4) a young diabetic child feeling dizzy; (5) a diabetic child showing behavioural disturbance; (6) addressing poor knowledge or responses in a parent (restricting the child's activity, providing inappropriate food or treats); and (7) a child showing reluctance to follow their treatment regime or to adopt responsibility. In each scenario, the participants were encouraged to decide on their own response first. The imaginary teacher's initial response was revealed (which did not produce the desired outcome). This provided the basis for discussion within the group on knowledge, practices, and attitudinal responses, together with what is best for children with diabetes (as well as other children within the teacher's care). The participants then discussed a number of different ways to think and respond to these given situations. The researcher and/or the diabetes educator acted as prompter, questioner and knowledge-provider, whilst allowing the participants to take ownership of seeking ways to manage and support children with diabetes effectively. Opportunities provided to practice skills (e.g., using a glucometer) and to engage in discussion with health professionals.

Part	Title	Time	Overview	Procedure
5	Plenary	10 mins	A plenary session of questions and open discussion.	This part presented a general discussion of diabetes-related issues, answering questions, and providing final encouragement to practice what had been learned in the other parts of the health education programme. A reminder was given to all participants of forthcoming days for the collection of data. A booklet addressing all of the key elements was also handed over to all teachers ('Diabetes and School' provided by King Faisal Specialist Hospital and Research Centre (2010), Appendix [2]).
	<b>TOTAL</b>	<b>180 mins</b>		

## **THE DATA COLLECTION PROCESS**

### **Finding Research Assistants**

The office of the Minister of Saudi Ministry of Health was contacted directly to ask if it could assist in finding qualified research assistants for the study. However, the office responded that there were no nurses available for the dates specified for collecting data for the study. Consequently, a meeting was arranged with the chief nurse of King Abdul-Aziz Hospital, which is one of the main government hospitals located in Jeddah. The researcher discussed the research study proposal with the chief nurse and managed to secure the services of two professional diabetes educators (one male and one female) to help with all aspects of data collection for the research study. Accessing male schools was not permitted for the female researcher so this posed a particular difficulty for the research study. The two professional diabetes educators were Saudi nationals each with Bachelor of Science degrees in nursing. The male educator had five years of experience as a diabetes educator, whilst the female educator had nine years.

A full day training session was held for the two diabetes educators on delivering the intervention in Saudi Arabia. This training included the basics of research principles, the importance of objectivity and bias, the research objectives, the content of the intervention and the mode of delivery. Another meeting was subsequently arranged to pass along the information about the recruitment process, dates and the process of delivering the intervention. Furthermore, the researcher and educators agreed to meet regularly to ensure that the programme was delivered with stability and fidelity to the research plan. The risk of gender differences impacting on the intervention process could not be addressed, but it gender-specific factors were likely to remain stable across both experimental and control groups with regard to data collection. Envelopes were provided for the head teachers of each school, each envelope containing six information sheets, six consent forms, six questionnaires, six leaflets, four compact discs, and extra copies of all materials. Tables with the arranged dates for administering the programme were also provided. The diabetes educators had to meet the head teachers in the first instance, with an approval letter for each diabetes educator and an authorization letter signed by the researcher which had been provided on behalf of the Saudi Ministry of Education (Appendix [3]).

## **Stages of Data Collection**

Data collection consisted of assessing the knowledge and attitudes of teachers regarding T1DM in children via a questionnaire at three time point. Testing commenced with the pre-test which was carried out immediately prior to the intervention. The pre-test assessment of the knowledge and attitudes of teachers regarding T1DM in children was collected via self-administered questionnaire in a group setting which were handed out to all participants in the experimental group and the control group. Self-administering the questionnaire in a group setting has many advantages. For instance, it allows for the questionnaire to be completed in a short amount of time. Furthermore, the researcher is still present to clarify questions and provide assistance when needed (Bourque and Fielder, 2003; Thornham, 2010).

If the test of knowledge were administered immediately after the training, it would not reveal what the participants would remember after an extended amount of time or if they were applying what they learned in their work. These 3 months intervals helped to ensure that the participants had remembered what they had learned in the health education programme. Moreover, since the questionnaire used in the post-test and follow-up test stages was identical to the one administered in the pre-test stage, these intervals also caused participants to depend on their newly acquired knowledge while answering the questions rather than simply remembering the questions themselves.

Following on from this, the intervention was applied to the experimental group only. The post-test was conducted after 3 months on both experimental groups and control groups. The post-test 2 was conducted after 6 months on both experimental and control groups. Following successful completion of this stage, the education programme was made available to the participants in the control group in order that all participants might benefit from the intervention.

## **The Self-Administered Questionnaire**

The International Diabetes Federation also contends that diabetes management in school environments are most effective when potential resources are identified and creative tools are generated in order to implement change (IDF, 2015). Accordingly, The questionnaire that was developed and used for the study was based on a review of the literature relating to teachers' knowledge and attitudes towards the



management of T1DM in children in school (Bradbury and Smith (1983); Lindsay (1987); Gormanous *et al.* (2002); Alnasir (2003); Nabors (2005); Gawwad (2008); Shuff (2011); Tahirović and Toromanović (2011); Aycan *et al.* (2012); Boden *et al.* (2012); Tannous *et al.* (2012).

A structured, multiple-choice, closed-ended, self-administered questionnaire was used to collect data from the participants (Appendix [4]). This format presented respondents with a limited list of response choices in order to enhance the overall reliability of the self-report instrument (Dillman *et al.*, 2009). The respondents filled in the instrument on-site at each school and were informed in advance that they should answer all the questions as best as they could. Steps taken to manage diabetes in school environments will vary across countries and school district, but the collective aim should be to impact positively on school environments for children with diabetes, and that begins with enhancing teachers' knowledge of diabetes in children (IDF, 2015).

A printed copy of the questionnaire was provided, and, on average, respondents took 15-20 minutes to complete the instrument. The questionnaire that was used for the intervention was in Arabic and was constructed directly in Arabic from sources in English and Arabic (Appendix [5]). It was subsequently translated into English for the purpose of reporting the results and was validated by checking the accuracy of the translation with other Arabic speakers who were university lecturers in the Linguistics Department at King Abdul-Aziz University in Jeddah. The instrument was a 75-item questionnaire that was split into three sections.

### **Questionnaire Section A**

Section A ("*About you*") covered 12 items which included demographic characteristics, teaching experience, and information about existing sources of T1DM knowledge to enable statistical comparison.

### **Questionnaire Section B**

Section B ("*Knowledge of type 1 diabetes (T1DM) in children*") included 41 statements about T1DM. This section was based on a 3-point Likert Scale, where True = 2, False = 1, and Don't Know = 0. The range of statements covered six areas: T1DM and onset symptoms; hyperglycaemia and ketoacidosis symptoms;

hypoglycaemia symptoms; complication of T1DM; hypoglycaemia and hyperglycaemia causes and treatment; and diet and controlling T1DM. These statements were designed to be short and clear in order to avoid confusion and to increase overall reliability of the instrument. Three examples are provided here.

- "Thirst is a symptom of hyperglycaemia in children with diabetes" (*question 20*).
- "Hypoglycaemia may be caused by too much insulin in children with diabetes" (*question 39*).
- "Children with T1DM need to eat more than 3 meals a day" (*question 51*).

### **Questionnaire Section C**

The International Diabetes Federation (2015) emphasizes the benefits of education programmes in terms of modifying behaviours, actions, and attitudes of teachers about children with T1DM by improving their empathy, self-awareness, and self-confidence in managing children with T1DM in their classrooms. Section C ("*Attitudes towards children with T1DM*") included 22 statements about behaviour and actions in respect of T1DM. This section was based on a strength of agreement scale, with the answers providing five alternative choices: (1) Strongly Agree; (2) Agree; (3) Neutral; (4) Disagree; and (5) Strongly Disagree. It was acknowledged that a 7-point strength of agreement scale would allow for stronger inferential statistical analysis, since this type of scale moves towards more continuous data than a 5-point strength of agreement scale which may constitute categorical or ordinal data (Rose, Spinks, and Canhoto, 2014, p. 217). However, it was also considered that a 7-point strength of agreement scale might confuse the participants.

For example, a 7-point scale might have included the following possible seven alternative choices: (1) Strongly Agree; (2) Mildly Agree; (3) Agree; (4) Neutral; (5) Disagree; (6) Mildly Disagree; and (7) Strongly Disagree. The difference between each of the three degrees of agreement or disagreement, while theoretically challenging, might also have lengthened the time taken to complete the questionnaire and therefore reduced compliance. Statements in this section covered diabetes practices involving doctors, public health workers, children, schools, peers,

and insulin injections and therapy. Since the statements were more descriptive, they may have been subject to a greater degree of variation in their interpretation. Examples of statements included the following.

- "T1DM care and management are not the responsibility of doctors only" (*question 54*).
- "Children with T1DM are not difficult to manage in the school" (*question 58*).
- "More information about T1DM would improve children's integration at school" (*question 67*).
- "Peers of children with T1DM should have opportunities for open discussion, so that they do not stigmatize diabetic children" (*question 74*).

### **Questionnaire Validity**

Validity is the degree to which an instrument measures what it is intended to measure (Meghan *et al.*, 2006). In order to be confident in the responses obtained from the questionnaires, the whole instrument was scrutinised in order to ensure that it was successful in measuring what it was designed to measure. Consequently to test the overall validity of the pilot research questionnaire it was reviewed by four endocrinologists and two diabetes educators from hospitals in both the UK and the KSA. The questionnaire was analysed for both face validity and content validity. Bryman (2012) notes that face validity is established by ensuring that the measure apparently reflects the content of the concept being studied. This is an essentially intuitive process because it can be established by asking individuals with experience or expertise in the relevant field to act as judges to determine whether the instrument seems to reflect the concept being studied (Bryman, 2012).

Del Greco *et al.* (1987) add that face validity refers to the appearance of the questionnaire, and whether it looks professional, as professional-looking questionnaires are more likely to obtain serious responses. In order to test face validity and improve face validity, the pilot questionnaire was critically assessed by the panel of experts. The comments and feedback from this analysis led to changes in the spacing of the questionnaire and the grouping of certain questions into

common groupings such as hyperglycaemia, hypoglycaemia, ketoacidosis, and complications. The pilot questionnaire was then tested using a group of 30 participants randomly selected from the study population, but from schools that were not included in the final research sample.

This was done to test for clarity and understanding of the instrument (Polit and Hungler, 1999). The participants were informed of the purpose of the pilot study. The pilot questionnaire was then distributed along with a feedback sheet for recording comments such as clarity of items, acceptability and ambiguity. Most comments were positive and the majority of participants understood the pilot questionnaire. However a few replies questioned the phrasing of certain questions such as blood glucose levels, and the meaning of certain terms such as 'ketones', 'meter', 'strips', 'candies', and 'ketoacidosis'. Because the amendments related to knowledge of medical terms which was being tested in the questionnaire, no amendments were made except for the phrasing of 'sweets' in Arabic.

Del Greco *et al.* (1987) state that content validity refers to whether the subject area to which the questionnaire relates has been adequately covered, and that all attributes within the subject area have been sufficiently and equally questioned. However, Kimberlin and Winterstein (2008) observe that because content validity cannot be measured statistically, it will usually depend on the judgment of experts in the field. The question that the experts need to ask themselves is "how well the items developed to operationalize a construct provide an adequate and representative sample of all the items that might measure the construct of interest" (Kimberlin and Winterstein, 2008, p.2279).

The panel of experts used to analyse the questionnaire for content validity considered that the range of questions asked in the knowledge (Section B) and attitudes (Section C) sections of the questionnaire would be sufficient to measure the relevant constructs. It was also observed that more demographic questions could be added if the researcher wished to research demographic backgrounds in more depth. Another expert commented that there seemed to be a slight imbalance between the knowledge section (41 questions) and the attitudes section (22 questions). However, the number of questions was not amended. This decision was taken on the basis that the questionnaire might become too lengthy for participants, and this might increase

the risk that participants would pay less attention to the final attitudes questions perhaps because of boredom or wanting to get the questionnaire over with, and consequently increase response bias in the questionnaire.

### ***Questionnaire Reliability***

Reliability refers to the extent to which the instrument produces consistent, stable, and dependable results (Sullivan, 2011). Sullivan (2011) states that reliability can sometimes be referred to as internal validity or internal structure of the assessment tool, and that Cronbach alpha is a test of international consistency that is frequently used to calculate correlation values of questionnaire answers. Kimberlin and Winterstein (2008) note internal consistency gives an estimate of the equivalence of sets of items from the same test. Consequently, the internal consistency coefficient provides an estimate of the reliability of measurement, assuming that items which are designed to measure the same construct should correlate (Kimberlin and Winterstein, 2008). The Cronbach alpha is described as "a function of the average intercorrelations of items and the number of items in the scale", so that "the greater the number of items in a summated scale, the higher Cronbach's alpha tends to be" (Kimberlein and Winterstein, 2008, p.2277).

The general minimum level of acceptability for the Cronbach alpha coefficient is  $\geq 0.70$  (Nunally, 1978). The coefficient for a good level of internal consistency is  $\geq 0.85$  (Polit and Beck, 2008). Table 9 shows the results of the Cronbach's reliability analysis, which indicate that the internal consistency of the knowledge section of the T1DM questionnaire was excellent ( $\alpha=.95$ ), as well as the internal consistency of the attitudes section ( $\alpha=.95$ ). The questionnaire was able to measure consistently, and the extent to which all the items in the questionnaire measured the same concept or construct was high. Consequently it can be seen that the questionnaire had a good level of internal consistency or reliability.

**Table 9: Reliability Statistics Knowledge and Attitude Test**

Reliability test	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Knowledge	0.953	0.956	41
Attitude	0.953	0.954	22

## DATA ANALYSIS

### Descriptive Statistics

The majority of research studies start with a summary of the data by using descriptive statistics (Mertler and Vannatta, 2010). The researcher applied descriptive statistical techniques to summarise and describe the important characteristic concerning the measurements used in research study (Mendenhall, Beaver, and Beaver, 2013). These techniques come in many forms and may include bar charts, pie charts, line charts, histograms, numerical tables, averages, percentages, and frequencies (Trochim, 2001; Lavrakas, 2008). Three main types of descriptive statistics are:

- (1) *Measures of central tendency*: mean (arithmetic average, mode (most frequently occurring score), and median (score that divides the upper 50% from lower 50%).
- (2) *Measures of variability*: range (difference between the highest and lowest score), quartile deviation (e.g. 25<sup>th</sup> percentile, 50<sup>th</sup> percentile, 75<sup>th</sup> percentile), standard deviation (average of scores away from the mean), and variance.
- (3) *Measures of relative position*: percentile rank (percentage of scores that fall at or below a certain score), and standard scores (e.g. z-score or t-score); and  
(4) measures of relationship: *Spearman rho* or *Pearson r* (Mertler and Vannatta, 2010).

Descriptive statistics were employed to describe the categorical data about the sample of primary school teachers in terms of gender, age groups, and level of education, and other questions in the *About You* section, and to summarise the data regarding participants' knowledge and attitudes towards children with T1DM.

### Inferential Statistics

Inferential statistical techniques were applied to answer research questions and test the null hypotheses. According to Mendenhall *et al.* (2013) inferential statistical procedures are used to make inferences or draw conclusions about population characteristics based on information obtained from a representative sample. Inferential statistics are associated with hypothesis testing, where the researcher

tests predictions made about the given sample (Steinberg, 2008; Mertler and Vannatta, 2010). Specific statistical criteria, known as significance tests, are used to test null hypotheses, and to help the researcher determine if there are statistically significant differences between sample means by using a pre-determined probability or alpha level.

Numerous tests can be used for hypothesis-testing including t-test and analysis of variance (Lavrakas, 2008; Mertler and Vannatta, 2010; Mendenhall *et al.*, 2013). In this study, the purpose was to examine the differences in the pre-test knowledge and pre-test attitudes scores of both the experimental and control groups in order to make inferences about the baseline knowledge and attitudes of the sample prior to administering the health education programme intervention. Comparison was made within groups to examine changes over time in scores for the experimental group and separately for the control group, and between groups to establish differences between them at each testing point.

### **Analysis of Variance**

Data analysis for the research was undertaken using the SPSS statistical package and using change-score analysis. When comparing the differences between two groups, t-tests are often the chosen method for statistical testing. However, the repeated use of t-tests increases the risk of incorrectly rejecting the null hypotheses (Steinberg, 2008). An independent samples t-test was calculated to evaluate the differences in pre-test scores between groups. Paired sample t-tests were conducted to examine differences between pre-test and post-test scores, and between pre-test and follow-up test scores after six months.

A series of ANOVA tests were utilised to reduce the risk of committing a Type I error (i.e., a false positive, or the incorrect rejection of a true null hypothesis) (Steinberg, 2008). According to Sapp (2006), ANOVA is a common analysis used in non-equivalent control group design. ANOVAs can be used to test simultaneously for any differences among two or more groups, or to examine how one group changes over time, identifying significant differences between or within groups (Mertler and Vannatta, 2010). The independent variable can be nominal or ordinal, relating to groups or characteristics, as in this case, control group and experimental group.

The dependent variable measures an outcome being studied by the researcher, where data being measured is on an interval or ratio scale (Sapp, 2006; Steinberg, 2008). For a factorial ANOVA there must be more than one independent variable. The independent variables in ANOVA represent the main effects (Gender, Age Group, Level of Education). For a factorial ANOVA there must be only one dependent variable. Therefore one factorial ANOVA examined the impact of the main effects (gender, age group, level of education) on Knowledge. Another factorial ANOVA examined the impact of the main effects (gender, age group, level of education) on Attitude.

### ***Analysis of Variance: Participants' Knowledge***

On the Knowledge section of the questionnaire, there were a total of 41 test-items (Questions 13 through Questions 53). The responses to the Knowledge questions were based on a 3-point Likert scale (0=False, 1=Don't Know, 2=True). Based on the number assignment, the score range was 0 to 82 points. So, if a person answered "FALSE" to all questions the highest possible score would be 0 ( $0 \times 41 = 0$ ). If a person answered "TRUE" to all questions, the highest possible score would be 82 ( $2 \times 41 = 82$ ). One study objective was to measure the participants' knowledge at pre-test, post-test, and post-test 2 stages after their exposure to the health intervention programme. In order to accomplish this, the participants' scores on the Knowledge section were summed. In order to facilitate a fairly even distribution of scores for each category, the number of Likert responses (3-points) were divided by the highest possible score (82 points) to give an idea about how to categorise the participants' knowledge levels ( $41/3 = 27.33$ , so approximately 27 points were used to divide each category).

So each Knowledge category (minimal, average, or substantial knowledge) was approximately based on these calculations to ensure a fairly even distribution of scores would fall within each category. Participants with scores between 0 to 27 points fell into the minimal knowledge category (28 points, if counted from 0 to 27 by hand). Participants with scores between 28-56 points fell into the average knowledge category (29 points, if counted from 28 to 56 by hand). Participants with scores between 57 to 82 points fell into the substantial knowledge category (26 points, if counted from 57 to 82 by hand).



### ***Analysis of Variance: Participants' Attitude***

On the Attitudes' section of the questionnaire, there were a total of 22 test-items (Questions 54 through Questions 75). The responses to the Attitudes' questions were based on a 5-point Strength of Agreement scale (1=Unfavourable Attitude, 2=Poor Attitude, 3=Neutral Attitude, 4=Satisfactory Attitude, 5=Favourable Attitude). Based on this number assignment, the score range was 22-110 points. So, if a person selected "1" for all questions the highest possible score would be 22 ( $1 \times 22 = 22$ ). If a person selected "5" to all questions, the highest possible score would be 110 ( $5 \times 22 = 110$ ). One study objective was to measure the extent of participants' attitudes at pre-test, post-test, and post-test 2 stages after their exposure to the health programme intervention.

In order to achieve this, the participants' scores on the Attitudes' section were summed. In order to facilitate a fairly even distribution of scores for each category, the number of Strength of Agreement responses (5-points) were divided by the highest possible score to give an idea about how to categorise the participants' attitude levels ( $110/5 = 22$ , so approximately 22 points were used to divide each category). So each Attitude category (unfavourable, poor, neutral, satisfactory, and favourable) was approximately based on these calculations to ensure a fairly even distribution of scores would fall with each category. Participants with scores 25 points or less, fell into the "unfavourable" category. Participants with scores between 26-46 points, fell into the "poor" category (21 points, if counted from 26 to 46 by hand). Participants with scores from 47-67, fell into the "neutral" category (21 points, if counted from 47 to 67 by hand). Participants with scores from 68-89, fell into the "satisfactory" category (22 points, if counted from 68 to 89). Participants with scores from 90-110, fell into the "favourable" category (21 points, if counted from 90 to 110 by hand).

### ***Analysis of Variance: Participants' Sociodemographic factors***

For the supplemental research questions, the independent variables were represented by the different sociodemographic factors, which were all categorical in nature: gender (0=male, 1= female); age group (0 = 25 - 34 years, 1 = 35 - 44 years, 2 = 45 - 54 years, and 3 = 55 years or older); years of teaching experience (0 = less than 5 years, 1 = 5 to 10 years, and 2 = more than 10 years); school sector (1 = public and 2 = private), level of education (1 = diploma/professional, 2 = bachelor

degree, and 3 = postgraduate). The dependent variables were measured by the participants' knowledge and attitudes.

### ***One-Way ANOVA Between-Groups***

A one-way ANOVA between-groups indicates that only one independent variable with two or more levels or factors is being used to make comparisons against one outcome (dependent) variable (Steinberg, 2008). This statistical test is referred to as between-groups, because it evaluates how groups are unique from each other. The intention was to determine how close or how distant the participants' knowledge and attitudes towards children with T1DM were at the onset of the study (pre-test) between the control and experimental groups. In order to accomplish this, the researcher had to ensure first that the assumptions of ANOVA were satisfied. These were: (1) that participants belonged to only one group, either control or experimental, but not both; (2) that the dependent variable was scaled (interval or ratio) and was normally distributed; and (3) that the variances between the groups were equal, i.e., homogeneity of variance (Steinberg, 2008).

The participants' total scores on the knowledge section and attitude section were checked for normality by calculating central tendency (mean, median, mode), shape of the distribution (histograms), variability (variance, standard deviation), and skewedness and kurtosis values being acceptable ( $\pm 1.00$ ) (Steinberg, 2008). Levene's statistics was used to test the assumption of homogeneity of variance, and it was accepted that the significance value should be greater than .05 to retain the null hypothesis that the variances between the groups are equal (Steinberg, 2008). The one-way ANOVA between-groups will produce the F statistic and its associated Sig. value (Steinberg, 2008) which guides the researcher in determining whether or not to retain or reject the null hypotheses. In the event that the assumptions of ANOVA are not satisfied, then alternative statistical tests should be used. Specifically if the variances between the groups are unequal, then Welch's ANOVA can be used to test for significant differences (Field, 2009).

### ***One-Way ANOVA Within-Groups***

A one-way ANOVA within groups indicates that a single group is being compared over time, and was used in this study to examine how one group changes at three points in time (Steinberg, 2008). The independent variable is categorical since it

represents a single sample or group, and the dependent variable is scaled (interval or ratio). For this study, pairs of one-way ANOVA repeated measures tests were utilised to measure the change over time in each of the groups' knowledge, and then attitude toward children with T1DM.

The assumptions of ANOVA within groups include a normal distribution of the dependent variables (as in the one-way ANOVA between subjects), and ensuring the homogeneity of covariance (across the three test points) has not been violated. The Mauchly's Test of Sphericity produces a Chi-square distribution and Sig. value, which should be greater than .05, to retain the null hypotheses regarding the homogeneity of co-variances (Steinberg, 2008). The resulting F statistic and its associated Sig. value help to determine whether to retain or reject the null hypotheses regarding the experimental and control groups' change in knowledge and attitude over time. In addition, the pairwise comparison generated by this statistical test allowed the researcher to observe how the participants' scores differed at the three testing points, and the partial eta statistic given by SPSS determined the effect size (Steinberg, 2008).

### ***Factorial ANOVA for Demographics***

A factorial ANOVA between-group requires that there are two independent variables (factors) with two or more levels (Steinberg, 2008), and it is used to test for significant mean differences in these groups (Mertler and Vannatta, 2010). The independent factors are categorical (nominal or ordinal), and the dependent variable is scaled (interval or ratio) (Lavrakas, 2008). This was used to examine the mean difference in the participants' pre-test knowledge scores based on the combination of two or more of the socio-demographic factors (gender, age group, level of education). This was repeated at the two post-test points. The dependent variable should be normally distributed, as previously described, and the homogeneity of variance between the different groups (socio-demographic factors) should be equal. If the F statistic and its associated Sig. value provided in Levene's test of equality of error variances is greater than .05, this assumption has not been violated and the error variance is assumed to be equal across groups (Lavrakas, 2008; Steinberg, 2008).

The results of the factorial ANOVA tests produce the main effect of each separate independent variable (gender, age group, level of education) on the dependent

variable (knowledge, attitude). The interaction between the combinations of independent variables used on the dependent variable was analysed. Interaction refers to all the possible combinations of the main effects and independent variables. For example, ANOVA will combine Gender and Age Group, and then produce an F statistic and p value, in order to determine if the interaction or combination of these two variables significantly impacts Knowledge. Then, the interaction between Gender and Level of Education will be carried out, and so on until all possible combinations have been analysed. The source table (tests of between-subjects effects) provides the F statistic and associated Sig. values to be used to determine whether or not the null hypotheses should be retained or rejected. The partial eta statistic given by SPSS indicates the effect size of the results.

### ***Paired Samples t-Test***

Paired sample t-test is used to compare one unique group at two points in time (Steinberg, 2008). The researcher examined the differences in the pre-test and post-test scores of participants in the experimental group, and the pre-test and post-test scores of the control group. Therefore, one paired sample is represented by the experimental group, and the second paired sample is represented by the control group. The independent variable is the pre-test score, and the dependent variable is the post-test score. Although t-test is robust to normality violations, the participants' knowledge and attitude scores were evaluated using central tendency, variability, and shape of distribution. For each paired sample, SPSS will provide paired sample statistics to observe the mean scores and standard deviations at both time periods, and paired samples correlations to indicate the strength and direction of the relationship between the pre-test and post-test scores for each group. The results of this t-test are provided as paired differences, which indicates the mean difference between pre-test and post-test scores for each paired group, along with the t statistic and its associated Sig. value which tells the researcher whether or not to retain or reject the null hypotheses. The effect size is calculated using Cohen's d, where the mean difference is divided by the standard deviation score (Steinberg, 2008).

### **LIMITATIONS**

There were several limitations of this study given that it was a quasi-experimental design rather than a true experimental design. Specifically, these restrictions are

related to: (1) the nature of quasi-experimental research; (2) threats to internal validity; (3) generalizability; and (4) the nature of a group study.

### **The Nature of Quasi-Experimental Research Design**

In quasi-experimental research designs, randomisation is not always possible for assigning participants to groups, therefore the participants are considered to be non-equivalent from the onset of the study (Bickman and Rog, 2009; Jackson, 2012). Uncontrollable, pre-existing extraneous variables might be present because of the nature of the groups (Sheskin, 2003; Jackson, 2012). As a result, the internal validity of quasi-experimental designs is weakened, and causal claims become more difficult to justify (Prater, 1983; Gribbons and Herman, 1997; Henrichsen, *et al.*, 1997). In this study, then, it could not be claimed with as much confidence that the changes in the dependant variables were a result of the intervention as they might could a true randomised control trial have been conducted.

The results had to be interpreted with caution since alternative explanations might still exist (Sheskin, 2003; Jackson, 2012). Rigorous attempts were made to improve the internal validity of the study by controlling, eliminating, or minimising known threats (Borg and Gall, 1989; Gravetter and Forzano, 2012). Selecting schools randomly was the best option in this regard, and this prevented the otherwise inevitable threat to the results from contamination between experimental and control groups if individual randomization had been applied. Comparison of pre-test results between groups was a measure to identify any pre-existing differences between the groups.

### **Threats to Internal Validity**

#### ***Maturation***

There are a number of threats to the internal validity of experimental designs. The maturation effect involves the natural changes in the participants who are studied over a period of time. The maturation can be physical, social, or cognitive in nature, and possibly responsible for any observed changes in the dependent variables (Bickman and Rog, 2009; Jackson, 2012). The participants in this study were observed and tested for over six months, so it is unlikely that they would have matured significantly as teachers or individuals in such a short time in their career. However, it is possible that the control group learned more about T1DM in children

simply by being tested. Pre-test and post-tests were used to minimise time-related threats of maturation and history. The pre-test and post-test scores for both groups of participants were evaluated to determine whether the intervention was associated to other time-related factors. Participants observed over the same time period should experience the same time-related factors, so the study design provided some evidence to support a cause-and-effect relationship (Gravetter and Forzano, 2012; Martella, Nelson, Morgan, and Marchand-Martella, 2013).

### ***Testing Effect***

Testing effect is another threat to internal validity for repeated measure designs, since repeated testing can lead to increases or decreases in scores. Changes in the participants' performance may be attributed to prior experience or knowledge of the test instead of the independent variable (Bickman and Rog, 2009). Participants were given the questionnaire on knowledge and attitudes towards children with T1DM three times during the course of this study. However, the extended time period between each test (three months) helped to minimise this threat (Lavrakas, 2008; Gravetter and Forzano, 2012). In further support of this proposition, the number of items on each assessment (41 questions for Knowledge and 22 questions for Attitudes) possibly made it more difficult for participants' to remember a lot of the questions from previous testing. Moreover, the control group design helped by allowing comparison of changes in scores over time between groups.

### ***Attrition***

Attrition refers to the loss of participants throughout the study, which can lead to a spurious difference in repeated measures comparisons since dropout may not be a random phenomenon. Internal validity can be affected by attrition so it was important to consider the characteristics of the participants who dropped out of the study (Bickman and Rog, 2009). At the onset of this study, the total sample consisted of 540 participants, but this number had decreased by the post-test to 513, and changed again at the follow-up test to 521. In order to reduce the attrition threat, participants who were unable to complete all three stages of the study were excluded, leaving a total number of 508 participants. This might have resulted in a skewed sample (for example, if all those who had been excluded were those who had struggled with the learning because of lower educational level). However, review

of the demographic profile of those who were excluded from the analysis showed this not to be the case, and no patterns were discernible in non-completers.

### **Contamination**

Diffusion or contamination of the intervention is yet another potential threat to internal validity (Cook and Campbell, 1979; Reichardt and Mark, 2001). This occurs when the insights or experiences of experimental and control group subjects are shared so that some of the effect of the intervention is experienced by control group participants. In this study, individual teachers within a school could not be randomised to experimental and control groups in a meaningful manner since they could have discussed issues and compared experiences, causing contamination of the data. Teachers of all grades from whole schools were allocated to a group together to overcome this threat. Randomisation was conducted at the level of whole schools rather than individuals.

### **Selection Bias**

In practice, the most highly pertinent threat to internal validity is selection bias (Cook and Campbell, 1979; Reichardt and Mark, 2001). Selection bias occurs when selected groups differ from each other or when the sample is not representative of the population (Crosby *et al.* 2006). The non-equivalent groups design approach adopted in this research study did not allow for randomisation of participants, therefore the possibility of selection bias arose. This effect was minimised by randomly selecting 90 schools out of the possible 683 to recruit participants, and by excluding participants who had received training in the management and care of children with T1DM in a school setting or who had first-degree relatives with T1DM. However, a number of statistical methods are available in order to take account of this selection bias (Reichardt, 2005). The effectiveness of the non-equivalent design in addressing the selection bias increases with the similarity of the pre-test scores (Martella *et al.*, 2013). This aspect was attended to carefully in this study, demonstrating the absence of any important differences between the two groups.

## **Threats to External Validity**

### **Generalizability**

External validity refers to generalizability, which is the degree to which the research findings can be applied to the target population under study (Crosby *et al.*, 2006).

This will apply in different settings, in different participants, at different times, and in different testing conditions (Baxter and Babbie, 2004). Quasi-experimental designs have greater threats to internal validity, but usually better external validity compared to experimental designs (Baxter and Babbie, 2004). Known threats to external validity that can influence and limit the generalizability of research outcomes may include: (1) sample characteristics; (2) setting characteristics; (3) temporal characteristics; (4) pretesting effects; (5) multiple treatment interferences; (6) high dropout rates (attrition); and (7) low response rates (Lavrakas, 2008). Attempts to avoid or control these known threats can help to increase the external validity, and thus the generalizability of the research outcomes (Lavrakas, 2008).

With regard to the sample characteristics, the researcher selected primary school teachers from all five regions of Jeddah, which represented the target population that was being studied. Both male and female teachers from both private and public schools were selected to participate. In addition, a large sample size was used to represent the population more accurately, so this threat was significantly reduced. With regard to the setting characteristics, the primary school teachers were surveyed at their respective schools, and participants in the experimental group were exposed to the intervention in their natural occupational setting, which helped to minimise threats to external validity.

For temporal characteristics, a detailed description and outline of data collections stages was provided in this report and other outputs, including how the intervention was designed and implemented with the experimental group. This allowed the study to be replicated using other samples from this population at different points in time. Whilst the researcher was able to control or minimise these previously mentioned threats to external validity, other threats reduced the generalizability of the research findings.

The study was undertaken using an objective quantitative research method rather than a subjective qualitative research method. It could not take into account the individual and subjective views, beliefs, opinions, and perceptions of the participants regarding the health education programme. However, this limitation was expressly acknowledged beforehand. The research study was conducted at a group (not



individual) level, so the research study cannot be used to assess individual participants' knowledge levels and attitudes towards children with T1DM.

It has been assumed that improvement in the knowledge and attitudes of primary school teachers by educational interventions will translate into improved care of children with T1DM in the school setting. The impact of this programme on children with T1DM, and on their parents requires further study.

The experiential knowledge and personal motivations of the researcher may have impacted on some aspects of the research process. With regards to the intervention, I relied upon my professional training as a nutritionist, nutritional educator to diabetes patients, and personal experiences as a mother of two children with T1DM, to develop a comprehensive health education programme for primary school teachers. In addition to lectures, the intervention was designed to be engaging and interactive, and teachers had an opportunity to internalize, apply, and then discuss the content. Moreover, I was motivated daily throughout the intervention phase due to my personal experience with my children. My passion, concern, and empathy about children with diabetes and diabetes management in schools could have exerted unrecognized influences on others as well as on my own decision-making.

## **ETHICAL ISSUES**

A broad range of ethical issues may arise in relation to research studies. These may arise at any stage of the research in connection with controversial, embarrassing, or sensitive subject matter of the research. Ethical issues may also arise in relation to the recruitment of the participants, especially in situations where participation may not be entirely voluntary (research with mentally incapacitated people), or when there is the potential for coercion, perhaps in situations where potential participants are emotionally vulnerable (United Kingdom Research Integrity Office, 2009). There can be language difficulties or barriers which may result in miscommunication of research aims and objectives, or the research may involve children or other individuals that are deemed to be vulnerable such as through mental illness or learning disability. Alternatively, there may be access or location risks that arise such as places with natural physical, biological or chemical hazards to which researchers may be exposed. Other potential ethical issues relate to privacy and confidentiality issues when dealing with participants and the data obtained from them.

According to 'The Code of Human Research Ethics' of The British Psychological Society (BPS), the principle of 'maximising benefit and minimising harm' involves considering all the research from the standpoint of the research participants, with the overall aim of avoiding potential risks to the mental health, psychological well-being, and personal values and dignity of the research participants (BPS, 2010). It is explained that harm to research participants is to be avoided, and that where unavoidable risks arise, robust risk assessment and management protocols should be developed and complied with, as well as putting in place measures to eliminate, minimise, or manage such risks (BPS, 2010).

### **The Approach to Research Ethics**

In this research the principles-based approach to research ethics was considered and evaluated, but it was ultimately rejected in favour of a risk-based approach to ethics which was considered to be more suited to the particular nature of the research. Long and Johnson (2007) note that a risks-based approach to research ethics often involves two considerations. The first is that the degree of risk to which any one or all the research participants are exposed should not exceed the potential benefits to be gained by their participation in the research (Long and Johnson, 2007). The second is that for any particular research study, researchers should identify all the relevant and potential risks involved, and should thereafter plan measures or procedures in order to avoid or minimise these risks (Long and Johnson, 2007). In this study, the main risks to the research participants were perceived coercion and the potential for breach of confidentiality.

### **The Risk of Perceived Coercion and Informed Consent**

Coercion has been defined in practice to include an explicit or implicit threat of some type of penalty arising owing to the failure to participate in a study (Polit and Beck, 2004). In this study, although there was no coercion or attendant duty to take part, there was the potential for participants mistakenly to believe that they were obliged to participate. This could have come about as a result of the Arabic culture and because of the hierarchical school environment. The means to correct any such misconception was to ensure accurate and adequate information. Normally, the information sheet should include a clear statement of all those aspects of the

research that are relevant for individuals when contemplating whether or not to take part in the research (BPS, 2010).

### **The Research Participant Information Sheet**

In order to eliminate or minimise to the greatest extent possible the risk of perceived coercion, all potential researchers were provided with a participant information sheet based on and conforming to the requirements of the UK Health Research Authority. The participant information sheet was prepared in English (Appendix [6]) and Arabic (Appendix [7]). In particular, the purpose of the research was made clear, together with what participation would involve. Emphasis was placed on the voluntary nature of participation and the right to withdraw from the study at any time without negative consequences. Confidentiality was assured, and details about who to contact regarding further information or complaints about the research were included.

### **The Research Participant Consent Form**

The participant consent form was designed taking into account relevant UK Health Research Authority guidance. The final printed form in English (Appendix [8]) was translated into Arabic (Appendix [9]) and signed by all research participants. The participant consent form outlined a number of statements in relation to the research which the participant was asked to initial in order to acknowledge that they had read each statement carefully. The form was then signed by the participant and the researcher. The consent form served as a means to verify that both parties acknowledged their roles and responsibilities.

### **The Potential for Breach of Confidentiality**

The risk of potential breach of confidentiality was addressed directly by putting in place security procedures (Economic and Social Research Council [ESCR], 2012). In practice, whilst personal details were required for the purpose of identifying participants, once recruited, each participant was allocated a study number. Personal details were kept separate from data, to be stored for five years after completion of the study (ESRC, 2012). All hard copies of data were also stored securely in a locked filing cabinet in a secure office when not in use, with access restricted only to the researcher and supervisor. All electronic data was also stored in a password-protected computer, and no identifying details were to be included in any reports or

presentations associated with, or undertaken as part of, the research study (ESCR, 2012).

### **Formal Ethical Approval**

Research ethical approval was obtained from the University of Salford Research Ethics Committee (Appendix [10]) and from the Saudi Arabian Ministry of Education prior to undertaking the research in the KSA (Appendix [11]). No unexpected ethical issues arose during the study.

## CONCLUSION

A health education programme for primary school teachers was developed regarding their knowledge and attitudes about children with T1DM. This quasi-experimental study was based on longitudinal research that involved paired samples t tests (pre-test/post-test) and repeated measures (baseline, 3 months, and 6 months). Additionally, the impact of age, gender, and level of education were examined using ANOVA. Stratified random sampling and purposive sampling techniques were utilized to recruit primary school teachers from 90 schools throughout Jeddah City in the KSA. Experimental group participants were selected from 60 schools, while control group participants were chosen from 30 schools. Following the recruitment process, a total of 540 primary school teachers were invited to participate in the study. School sessions were scheduled by the head teacher at each school, where six teachers were expected to attend. The health education programme was implemented and lasted for 9 weeks (6 weeks for the experimental group; 3 weeks for control group at the end of the study and after completion of data collection). The intervention consisted of 5 main parts: introduction, setting the scene, overview of key diabetes issues, interactive learning, and plenary. Two diabetes educators assisted with the intervention and data collection phases. A self-administered questionnaire was used to collect demographic data (12 items), and to measure the participants' knowledge of T1DM in children (41 items) and attitudes toward children with T1DM (22 items). The overall reliability and validity of this instrument was satisfactory. Study limitations included threats to internal validity in terms of maturation, testing effect, attrition, contamination, and selection bias, as well as threats to external validity, though these were minimised as much as was possible. Ethical concerns were addressed to ensure that participants' anonymity and confidentiality rights were safeguarded. The voluntary basis of participation in the study was clarified, informed consent was obtained and other steps taken by the researcher to minimise potential danger or harm to the participants.

## CHAPTER 5

### RESEARCH STUDY RESULTS

#### INTRODUCTION

This chapter includes a report of the statistical analysis of data. It starts with the demographics of the sample of 540 primary school teachers in detail, and then comparisons between control and intervention groups at three different time points pre-test (baseline), post-test (3 months) and post-test 2 (6 months) are presented. Scores are calculated from the study variables and analysed to answer the eight research questions.

#### DATA DESCRIPTION

The demographic variables of sample data included: (1) gender; (2) age; and (3) the education level of primary school teachers. These demographic categories were evaluated with regard to the research study variables, namely the knowledge of primary school teachers; and the attitudes of primary school teachers towards T1DM in children located in Jeddah City. Initially, 540 participants were recruited in the sample. Then to control for selection bias, participants with first relatives with T1DM or previous training in managing children with T1DM in a school setting were excluded from this study. Table 10 shows that 193 (35.7%) of the initial sample had relatives with T1DM, and 26 (4.8%) of the sample had prior training. A total of 540 primary school teachers were included in the pre-test, 513 in post-test, and 521 in post-test 2. The difference in total number for each stage was due to missing values, which caused another 46 cases to be deleted from the dataset. The total sample size for full data analysis consisted of 318 primary school teachers.

**Table 10: Participants with relatives who have T1DM and with prior training**

Variable	N	Percentage
<b>Participants with relatives</b>		
Yes	193	35.70%
No	347	64.30%
<b>Participants with prior training</b>		
Yes	26	4.80%
No	514	95.20%

## STATISTICAL HYPOTHESES

The following null hypotheses were tested in this study.

- **H<sub>01</sub>:** Knowledge pre-test scores will not differ significantly between the control and experimental groups.
- **H<sub>02</sub>:** Attitude pre-test scores will not differ significantly between the control and experimental groups.
- **H<sub>03</sub>:** Participants who receive the health education programme intervention will show no significant difference in their knowledge between pre-test and post-test scores.
- **H<sub>04</sub>:** Participants (control) who did not receive the health education programme intervention will show no significant difference in their knowledge between pre-test and post-test scores.
- **H<sub>05</sub>:** Participants who received the health education programme intervention will show no significant difference in their attitude between pre-test and post-test scores.
- **H<sub>06</sub>:** Participants (control) who did not receive the health education programme intervention will show no significant difference in their attitude between pre-test and post-test scores.
- **H<sub>07</sub>:** There is no significant change in knowledge about children with T1DM shown by the control group between the pre-test and post-test 2 stages.
- **H<sub>08</sub>:** There is no significant change in knowledge about children with T1DM shown by the experimental group between the pre-test and post-test 2 stages.
- **H<sub>09</sub>:** There is no significant change in attitude about children with T1DM shown by the control group between the pre-test and post-test 2 stages.

- **H<sub>0</sub>10:** There is no significant change in attitude about children with T1DM shown by the experimental group between the pre-test and post-test 2 stages.
- **H<sub>0</sub>11:** Socio-demographic factors (age, gender, education level) will exert no significant difference on the experimental group's knowledge pre-test scores.
- **H<sub>0</sub>12:** Socio-demographic factors (age, gender, education level) will exert no significant difference on the experimental group's attitude pre-test scores.
- **H<sub>0</sub>13:** Socio-demographic factors (age, gender, education level) will exert no significant difference on the experimental group's knowledge post-test scores.
- **H<sub>0</sub>14:** Socio-demographic factors (age, gender, education level) will exert no significant difference on the experimental group's attitude post-test scores.

## A DESCRIPTION OF THE PARTICIPANTS' DEMOGRAPHICS

The sample consisted of primary school teachers (n=318).

Table 11 shows the distribution of the participants to either the control group (n=109) or the experimental group (n=209).

**Table 11: Participants' characteristics**

Participants' characteristics	Group		Total
	Experimental Group (n=209) n(%)	Control Group (n=109) n(%)	
<b>Gender</b>			
Male	117(63.90%)	66(36.10%)	183
Female	92(68.10%)	43(31.90%)	135
<b>Age Groups</b>			
25 – 34	58(64.40%)	32(35.60%)	90
35 – 44	87 (60.00%)	58(40.00%)	145
45 – 54	37 (69.80%)	16 (30.20%)	53
55 or older	27 (90.00%)	3 (10.00%)	30
<b>Education Level</b>			
Diploma	19 (73.10%)	7 (26.90%)	26
Bachelor	186 (65.00%)	100 (35.00%)	286
Postgraduate	4 (66.70%)	2 (33.30%)	6



## **Gender**

Table 11 shows the distribution of the participants with regard to their gender. In the experimental group, there were slightly more male participants (n=117) than females (n=92). Likewise in the control group, male participants (n=66) outnumbered female participants (n=43). Although the participants were initially distributed equally between male and female schools, the exclusion of teachers outlined above resulted in a final unequal male to female ratio.

## **Age**

Table 11 indicates the age distribution of the participants in each group. There was an uneven distribution of participants across each of the age groups, both in the experimental group and the control group. There was a distinct underrepresentation of the age group 55 or older in the control group (n=3). Overall for both groups, the 35-44 year olds represented the largest age group (n=145), while the 55 year olds and older represented the smallest age group (n=30). The increased numbers in the experimental group were to be expected given the larger proportional size as compared to the control group, i.e. experimental group approximately 0.66% and control group approximately 0.33%.

## **Level of Education**

Table 11 shows that the majority of participants in both groups held a bachelor's degree (n=286), and only a few participants had a postgraduate degree (n=6). More participants in the experimental group had high school diplomas (73.10%), than those in the control group (26.90%). Similarly, the number of participants with a bachelor's degree in the experimental group (65.00%) exceeded the number in the control group (35.00%). The majority of participants in both the experimental (92.8%) and control (93.6%) groups reported that their schools did not have a facility to monitor students with T1DM (Table 12).

**Table 12: Availability of health support in schools**

Facility in School	Group		Total
	Experimental Group n(%)	Control Group n(%)	
Does the school have a health specialist to deal with pupils with T1DM?			
Yes	20 (9.60%)	9 (8.3%)	29
No	189 (90.40%)	100 (91.70%)	289
Does the school have a facility to monitor pupils with Type 1 Diabetes?			
Yes	15 (7.20%)	7 (6.40%)	22
No	194 (92.80%)	102 (93.60%)	296
Are there pupils with T1DM in the class?			
Yes	43 (20.60%)	20 (18.30%)	63
No	166 (79.40%)	89 (81.70%)	255

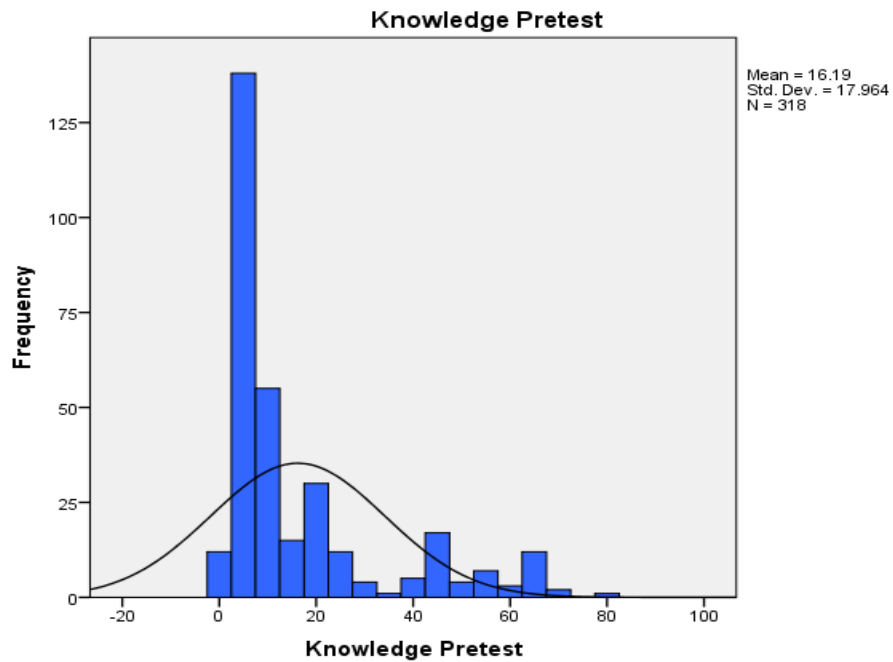
The majority of participants in both the experimental (90.4%) and control (91.7%) groups reported that there was no school health specialist to address the needs of children with T1DM (Table 12). More participants in the experimental group had students with T1DM in their classroom (79.4%) compared to participants in the control group (52.2%).

## **PRE-ASSESSMENT OF THE SAMPLE AT PRE-TEST**

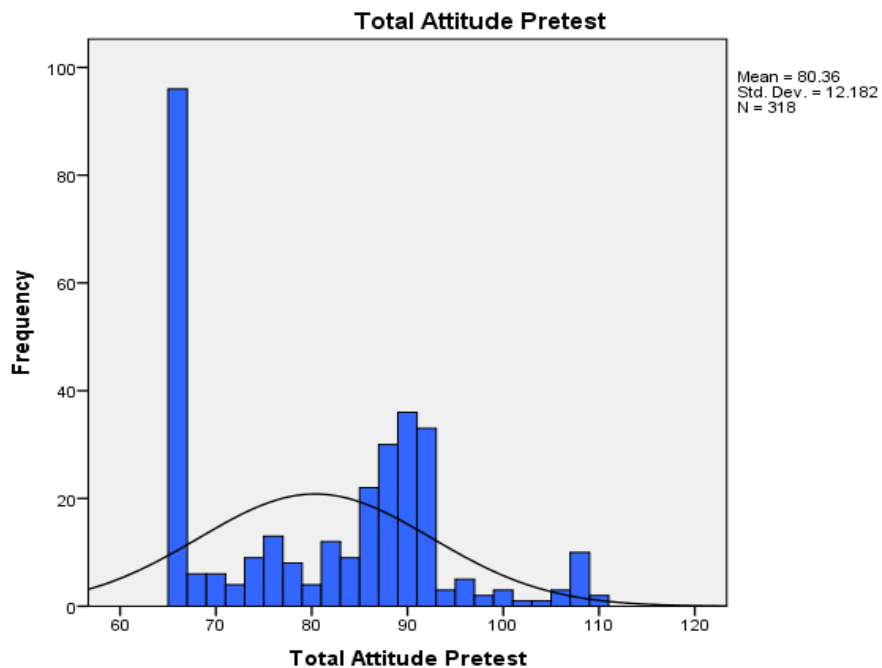
### **Knowledge**

A one-way ANOVA between-subjects test was conducted to examine differences in the pre-test knowledge scores between the control and experimental groups. First, the assumptions of ANOVA were tested using descriptive statistics and Levene's test of equality variances. The measures of central tendency for the pre-test knowledge scores were not close in range, but the skewness and kurtosis values were acceptable, since they did not exceed  $\pm 2.00$  (Lomax & Hahs-Vaughn, 2012). This demonstrated that the scores conformed to a normal univariate distribution. Figure 7 and Figure 8 indicate that the distribution of scores was positively skewed. This means that the majority of the scores fell towards the lower side of the scale and very few higher scores were recorded. This would tend to indicate that the pre-test levels of knowledge were low overall.

**Figure 7: Histogram of Knowledge Pre-test Score**



**Figure 8: Histogram of Attitude of Pre-test Score**



However, the results of the Levene's test were significant ( $p=.03$ ) which indicated that the variances between the groups were not equal. In principle this violated the homogeneity assumption of ANOVA. Consequently Welch's ANOVA was used as an alternative to test for significant differences between the groups. The control group scored higher on the knowledge pre-test ( $M=18.12$ ,  $SD=19.832$ ) than the experimental group ( $M=15.18$ ,  $SD=16.870$ ). The result of Welch's ANOVA was not

significant ( $F(1,190.79)=1.742$ ,  $p=.19$ ), therefore the null hypothesis was supported. There were no statistically significant differences between the control group and experimental group based on their pre-test knowledge scores.

## Attitude

The same process was applied to assess the differences in the pre-test attitudes scores of the control and experimental groups. First, the assumptions of ANOVA were tested using descriptive statistics and Levene's test of equality variances. The measures of central tendency for the pre-test knowledge scores were not close in range, but the skewness and kurtosis values were acceptable, since they did not exceed  $\pm 2.00$  (Lomax & Hahs-Vaughn, 2012). This demonstrated that the scores conformed to a normal univariate distribution. The distribution of pre-test attitude scores was positively skewed. However, the results of the Levene's test were significant,  $p<.001$ , which indicates that the variances between the groups were not equal. In principle this violates the homogeneity assumption of ANOVA. Therefore the Welch's ANOVA was used as an alternative to test for significant differences between the groups.

Table 13 shows that the experimental group had higher attitude scores ( $M=80.52$ ,  $SD=12.957$ ) than the control group ( $M=80.07$ ,  $SD=10.588$ ). The results of the Welch's ANOVA were not significant ( $F(1, 260.18)=.107$ ,  $p=.743$ ), therefore, the null hypothesis was retained. There was no statistically significant difference between the two groups based on their pre-test attitude scores.

**Table 13: Comparison of Knowledge and Attitude, Robust Tests of Equality of Means Pre-test Scores between experiment and control groups**

Pre-test scores	Group		p value
	Experimental Group n=209, mean $\pm$ SD	Control Group n=109, mean $\pm$ SD	
Knowledge	15.18 $\pm$ 16.87	18.12 $\pm$ 19.83	0.188
Attitude	80.52 $\pm$ 12.96	80.07 $\pm$ 10.59	0.743

As a result of the absence of any statistically significant difference between the groups at the pre-test point, it was deemed to be acceptable to proceed to statistical testing of differences between the groups at the post-test and post-test 2 stages.

### **RESEARCH QUESTION 1**

**Is there a difference between the control and experimental groups' knowledge about children with T1DM at the pre-test stage?**

Section B of the study Research Instrument contained 41 questions regarding knowledge of T1DM in children. The overall mean score for the control group and for the experimental group was similar in magnitude and showed their average level of knowledge of T1DM at the 16.65 (15.18 + 18.12) level. It is accepted that a 2.94 difference in the mean scores between the control and experimental groups is within an acceptable level of variance, and therefore there was no significant statistical difference between the control and experimental groups' knowledge about children with T1DM at the pre-test stage.

### **RESEARCH QUESTION 2**

**Is there a difference between the control and experimental groups' attitudes towards children with T1DM at the pre-test stage?**

Section C of the study Research Instrument contained 22 questions regarding attitudes towards children with T1DM. The overall mean score for the experimental and for the control group were similar in magnitude and showed an average level of attitudes towards children with T1DM at the 80.30 (80.52 + 80.07) level. It is accepted that a 0.45 difference in the mean scores between the control and experimental groups is within an acceptable level of variance, and therefore there was no significant statistical difference between the control and experimental groups' attitudes towards children with T1DM at the pre-test stage.

## **POST-TEST RESULTS**

The results from paired samples t-test were utilised to compare the mean differences in the participants' pre-test and post-test knowledge and attitude scores, given that the assumptions of normality were satisfied.

## **KNOWLEDGE TESTS RESULTS**

Table 14 shows that the distribution of pre-test and post-test knowledge scores were fairly close in range, and the skewness and kurtosis values were acceptable, since

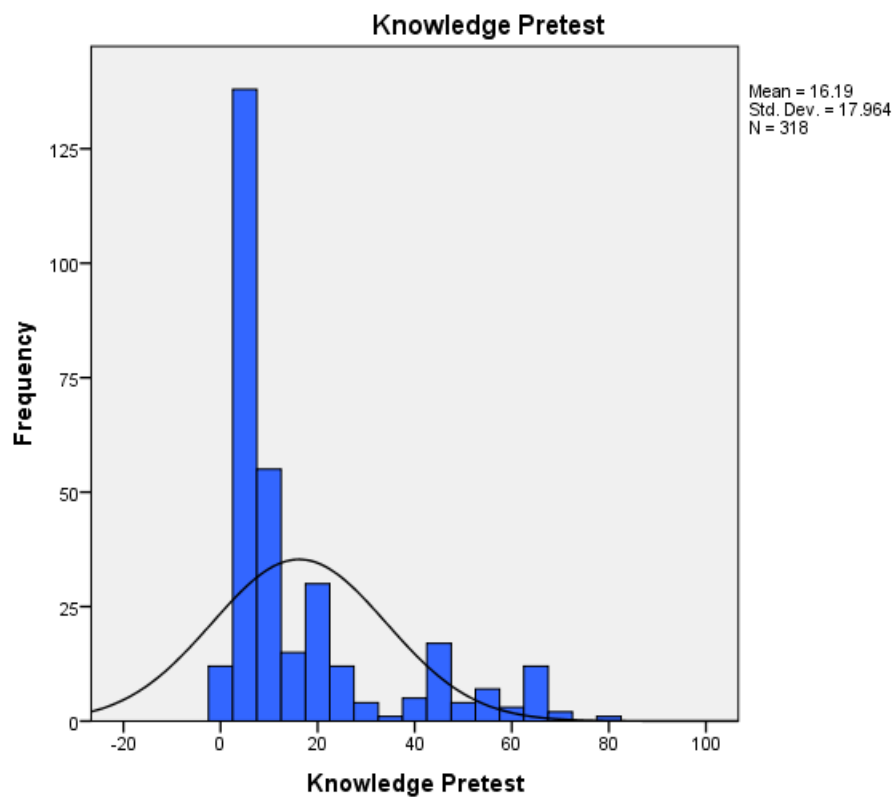
they did not exceed  $\pm 2.00$  (Lomax & Hahs-Vaughn, 2012). This demonstrates that the scores conformed to a normal univariate distribution.

**Table 14: Pre-test and Post-test Knowledge Scores**

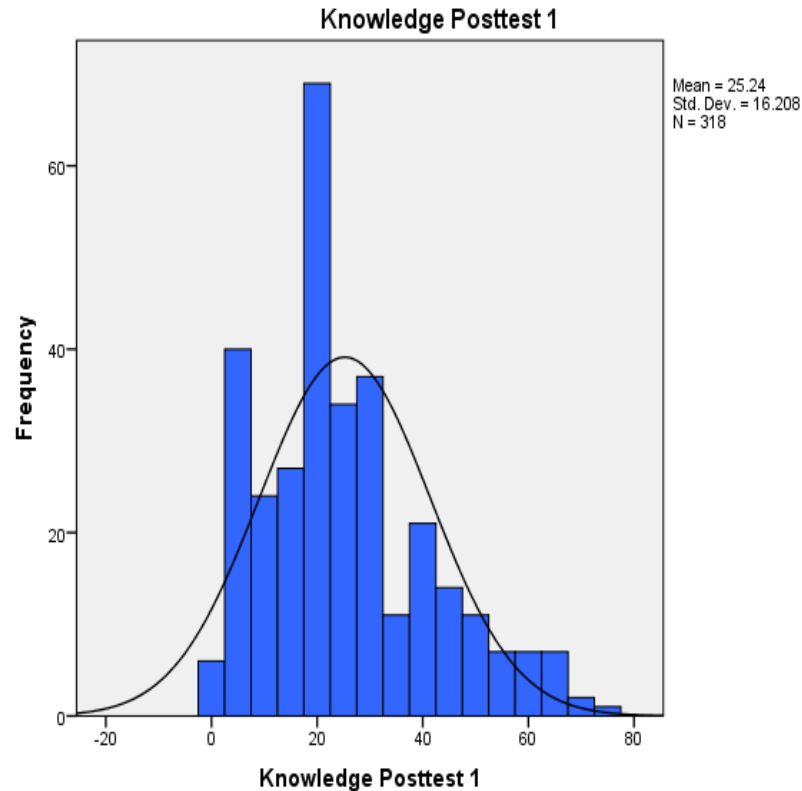
Group	n	Pre Test mean	Post Test mean	p value
		$\pm$ SD	$\pm$ SD	
Overall	318	16.19 $\pm$ 17.96	25.24 $\pm$ 16.21	
Experiment Group	209	15.18 $\pm$ 16.87	29.85 $\pm$ 13.26	<0.001
Control Group	109	18.12 $\pm$ 19.83	16.04 $\pm$ 17.67	0.002

Figure 9 and Figure 10 show that both the pre-test and post-test knowledge scores were positively skewed. This means that the majority of the scores fell towards the lower side of the scale and very few higher scores were achieved. This would tend to indicate that both the pre-test and post-test levels of knowledge were low overall.

**Figure 9: Histogram of Knowledge Pre-test Scores**



**Figure 10: Histograms of Knowledge Post-test Scores**



### **Experimental Group's Knowledge Results**

The experimental group scored much higher on the knowledge post-test ( $M=29.85$ ,  $SD=13.263$ ) than on the knowledge pre-test ( $M=15.18$ ,  $SD=16.870$ ). The increase in the mean level of knowledge between the pre-test and the post-test stage was 14.67, which indicated an increase of 96.64%. The relationship between the pre-test and post-test knowledge scores for participants in the experimental group was positive and very strong ( $r=.711$ ). This demonstrated a strong linear relationship between the two variables such that post-test knowledge scores were highly correlated to pre-test scores. The mean difference between the experimental group pre-test and post-test knowledge scores was -14.675 ( $SD=11.931$ ), and statistically significant ( $t(208)=-17.781$ ,  $p<.001$ ). The null hypothesis was rejected, and participants who received the health education programme intervention showed a significant difference in their knowledge pre-test and post-test scores. The intervention was shown to increase teachers' knowledge.

### **Control Group's Knowledge Results**

The participants in the control group scored slightly lower on the knowledge post-test ( $M=16.40$ ,  $SD=17.674$ ) than they did on the knowledge pre-test ( $M=18.12$ ,

$SD=19.832$ ). The decrease in the mean level of knowledge between the pre-test and the post-test stage was 1.72, which indicated a decrease of 9.49%. The relationship between the pre-test and post-test knowledge scores for participants in the control group was positive and very strong ( $r=.96$ ). This shows a strong linear relationship between the variables such that post-test knowledge scores were highly correlated to pre-test scores, indicating a consistency of treatment effect across participants. The mean differences between the control group pre-test and post-test knowledge scores was 1.716 ( $SD=5.556$ ) and statistically significant ( $t(108)=3.224$ ,  $p=.002$ ), so the null hypothesis was rejected, and participants (control) who did not receive the health education programme intervention experienced a significant difference between their knowledge pre-test and post-test scores, though the level of knowledge decreased.

## ATTITUDE TESTS RESULTS

Table 15 shows that the pre-test and post-test attitude scores were fairly close in range, and the skewness and kurtosis values were acceptable, since they did not exceed  $\pm 2.00$  (Lomax & Hahs-Vaughn, 2012). This demonstrates that the scores conformed to a normal univariate distribution.

**Table 15: Pre-test and Post-test Attitude Scores**

Group	n	Pre Test, mean	Post test, mean	p value (t test)
		$\pm SD$	$\pm SD$	
Overall	318	80.36 $\pm$ 12.18	83.86 $\pm$ 11.11	
Experiment Group	209	80.52 $\pm$ 12.96	85.14 $\pm$ 10.34	<0.001
Control Group	109	80.07 $\pm$ 10.59	81.39 $\pm$ 12.14	0.262

Figure 11 and Figure 12 indicate that the distribution of scores was positively skewed for both the pre-test and post-test attitude scores. This means that the majority of the scores fell towards the lower side of the scale with very few higher scores achieved. This would tend to indicate that both the pre-test and post-test attitudes scores were low overall.



Figure 11: Histogram of Attitude Pre-test Scores

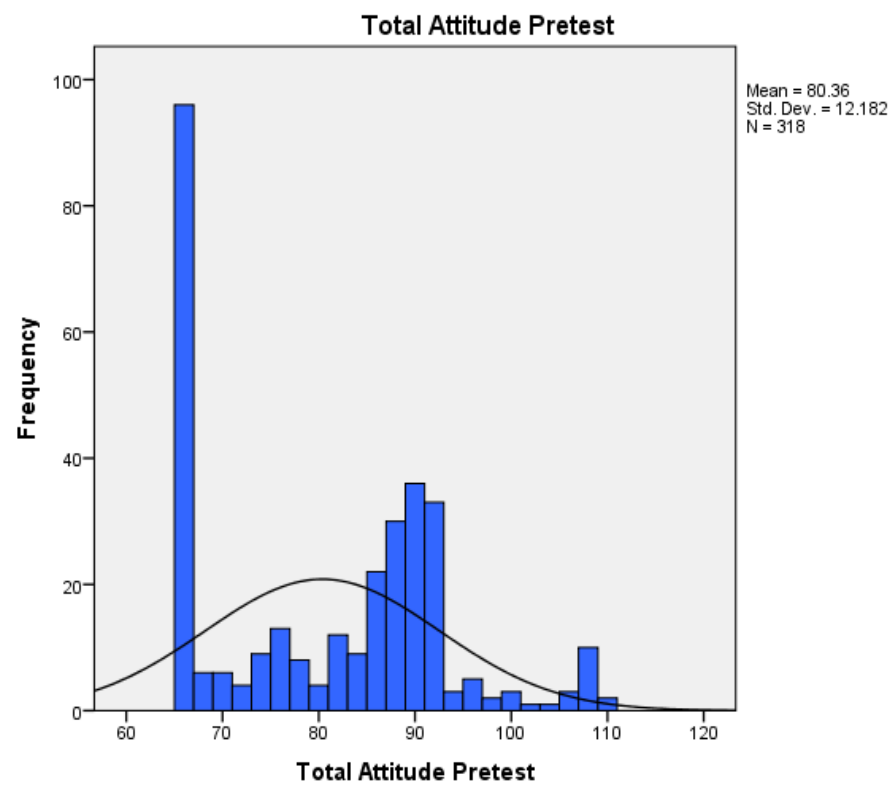
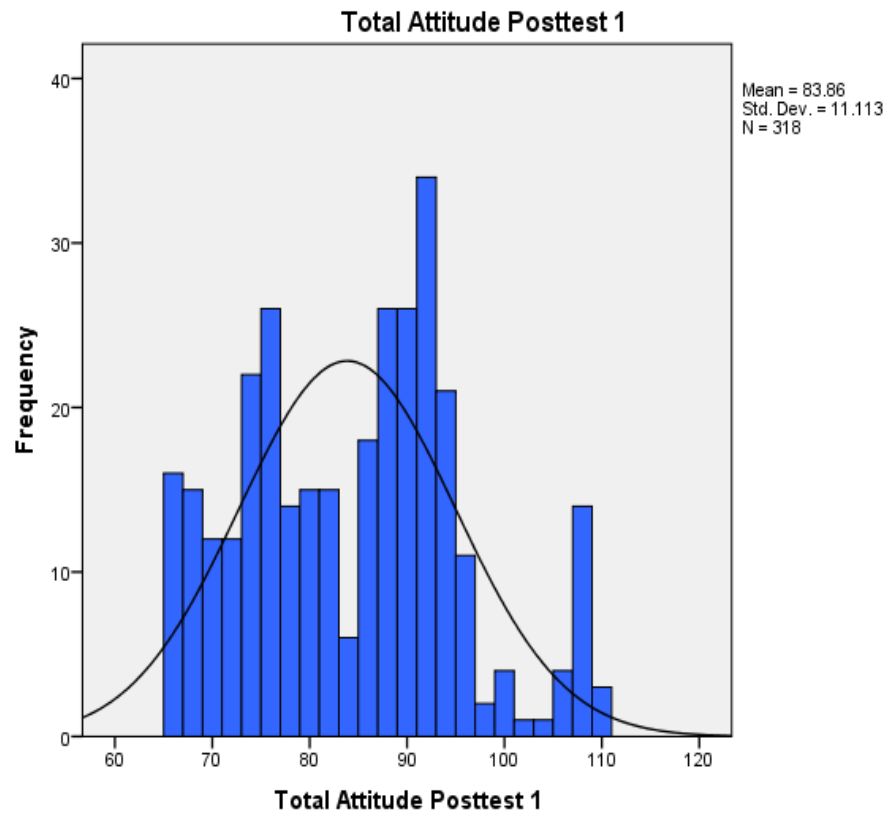


Figure 12: Histogram of Attitude Post-test Scores



## Experimental Group's Attitude Results

The participants in the experimental group had better attitudes towards children with T1DM following the health education programme ( $M=85.14$ ,  $SD=10.338$ ) than before the intervention ( $M=80.52$ ,  $SD=12.957$ ). This was an increase in the mean of 4.62 which represented a 5.74% increase in attitude scores. The relationship between the experimental group's pre-test and post-test attitude scores was positive and very strong ( $r=.93$ ). This demonstrated a strong linear relationship between the two variables such that post-test attitude scores were highly correlated to pre-test scores, indicating a consistency of treatment effect across participants. The mean difference between the experimental group pre-test and post-test attitude scores was -4.627 ( $SD=5.032$ ) and statistically significant ( $t(208)=-13.293$ ,  $p<.001$ ). Therefore the null hypothesis was rejected and participants who received the health education programme intervention demonstrated a significant improvement between their pre-test and post-test attitude scores.

## Control Group's Attitude Results

The participants in the control group had slightly better attitudes towards children with T1DM after three months, ( $M=81.39$ ,  $SD=12.138$ ) than they did at the onset of the study ( $M=80.07$ ,  $SD=10.588$ ). This was an increase in the mean of 1.32 which represented a 1.655% increase in attitude scores. The relationship between the control group pre-test and post-test attitude scores was positive and moderately strong ( $r=.43$ ). This demonstrated that post-test attitude scores were moderately strongly correlated to pre-test scores. The mean difference between the control group pre-test and post-test attitude scores was -1.321( $SD=12.243$ ), but not statistically significant ( $t(108)=-1.127$ ,  $p=.26$ ). The null hypothesis was retained, and participants who did not receive the health education programme intervention showed no significant difference between their pre-test and post-test attitude scores.

### RESEARCH QUESTION 3

**Is there a difference between the experimental group's knowledge pre-test and post-test scores following the health education programme intervention?**

The pre-test knowledge mean score for participants in the experimental group was 15.18, which increased to 29.85 three months after they were exposed to the health education programme. The difference in these mean scores (an increase of 14.675

equating to a 96.64% increase) was statistically significant. The conclusion that could be drawn from these results was that primary school teachers in the experimental group had very significantly improved their knowledge of T1DM management in school children following the health education programme intervention (nearly a 100% improvement).

#### **RESEARCH QUESTION 4**

**Is there a difference between the control group's knowledge pre-test and post-test scores?**

The pre-test knowledge mean score for participants in the control group was 18.12, which decreased to 16.40 three months later at post-test. The mean difference in these scores (a decrease of 1.72 equating to a 9.49% decrease) was statistically significant. The conclusion that can be drawn from these results was that primary school teachers in the control group showed a significant worsening in their knowledge about T1DM in children after three months.

#### **RESEARCH QUESTION 5**

**Is there a difference between the experimental group's attitude pre-test and post-test scores following the health education programme intervention?**

The pre-test attitude mean score for participants in the experimental group was 80.52, which increased to 85.14 three months after they were exposed to the health education programme. The mean difference between these scores (an increase of 4.62 equating to a 5.74% increase) was statistically significant. The conclusion that can be drawn from these results was that primary school teachers in the experimental group showed a significant increase in their attitudes towards children with T1DM three months after receiving the health education programme intervention.

#### **RESEARCH QUESTION 6**

**Is there a difference between the control group's attitude pre-test and post-test scores?**

The pre-test attitude mean score for participants in the control group was 80.07,

which increased slightly to 81.39 three months after they received no intervention. The mean difference in these scores (an increase of 1.32 equating to a 1.65% increase) was not statistically significant. The conclusion that can be drawn for these results was that although attitudes of primary school teachers towards children with T1DM in the control group increased after three months, this increase was not statistically significant.

## REPEATED MEASURES

### Knowledge Levels for the Experimental Group

Table 16 shows that the participants in the experimental group improved their knowledge scores over time. Their highest knowledge scores came six months after they were exposed to the health education programme ( $M=32.93$ ,  $SD=14.101$ ), whilst their lowest scores were recorded prior to the intervention ( $M=15.18$ ,  $SD=16.870$ ). This shows that the participants had increased their knowledge at the post-test stage (3 months) and at the post-test 2 stage (6 months).

**Table 16: Repeated Knowledge Statistics for Experimental Group**

Knowledge test scores	N	mean $\pm$ SD
Pre-test	209	15.18 $\pm$ 16.87
Post-test	209	29.85 $\pm$ 13.26
Post-test 2	209	32.93 $\pm$ 14.10

*Greenhouse-Geisser*

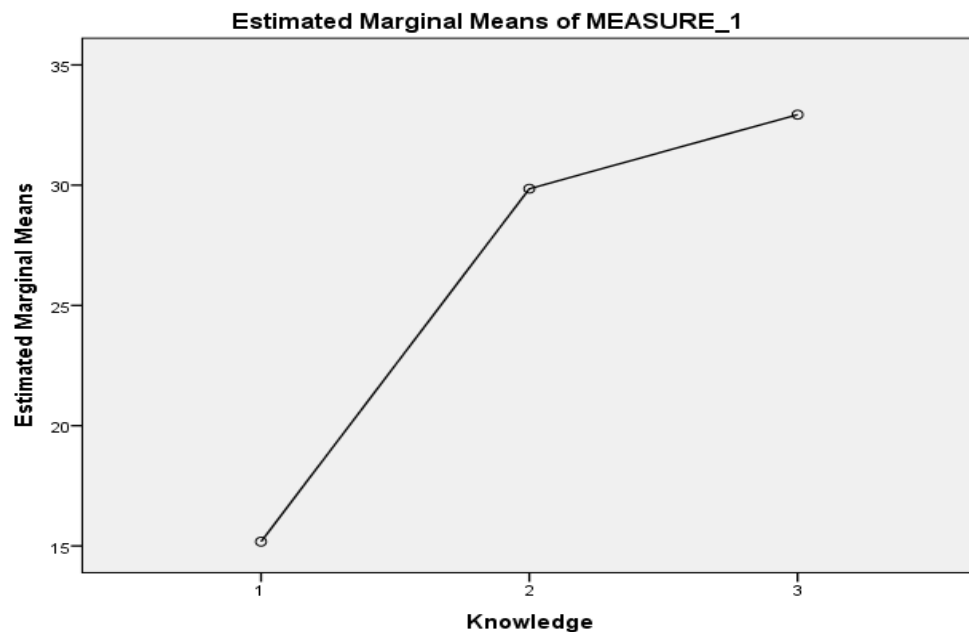
$F=36.07$  ( $df=1.33, 277.25$ ),  $P$  value  $<0.0001$

The results of Mauchly's test were significant ( $X^2(2) = 204.655$ ,  $p < .001$ ), which violated the assumption of sphericity. Consequently, the Greenhouse-Geisser corrected value of  $F$  was used to determine significance. The results of repeated measures ANOVA indicated that the knowledge levels of participants in the experimental group were affected over time ( $F(1.23, 255.54) = 356.382$ ,  $p < .001$ ). The differences in the mean scores were statistically significant, so the null hypothesis was rejected. The results show that there was a significant change in knowledge over time for the participants in the experimental group, over a period of 3 months and over a period of 6 months.

Figure 13 shows the unweighted means of knowledge for the experimental group

calculated to control for the effect of other variables. The results are consistent with the findings and the plot shows that the level of knowledge of the experimental group significantly increased at the post-test stage and continued to increase up until the post-test 2 stage.

**Figure 13: Mean Plot of Knowledge Scores for the Experimental Group**



### Knowledge Levels for the Control Group

Table 17 indicates that the participants in the control group had higher knowledge scores at the onset of the study ( $M=18.12$ ,  $SD=19.832$ ) and the lowest knowledge scores after three months of participating in the study ( $M=16.40$ ,  $SD=17.674$ ). The results of Mauchly's test were significant ( $X^2(2)=76.060$ ,  $p<.001$ ), which violated the assumption of sphericity. Therefore the Greenhouse-Geisser corrected value of  $F$  was used to determine significance.

**Table 17: Repeated Knowledge Statistics for Control Group**

Knowledge test scores	n	mean $\pm$ SD
Pre-test	109	18.12 $\pm$ 19.83
Post-test	109	16.40 $\pm$ 17.67
Post-test 2	109	17.48 $\pm$ 19.31

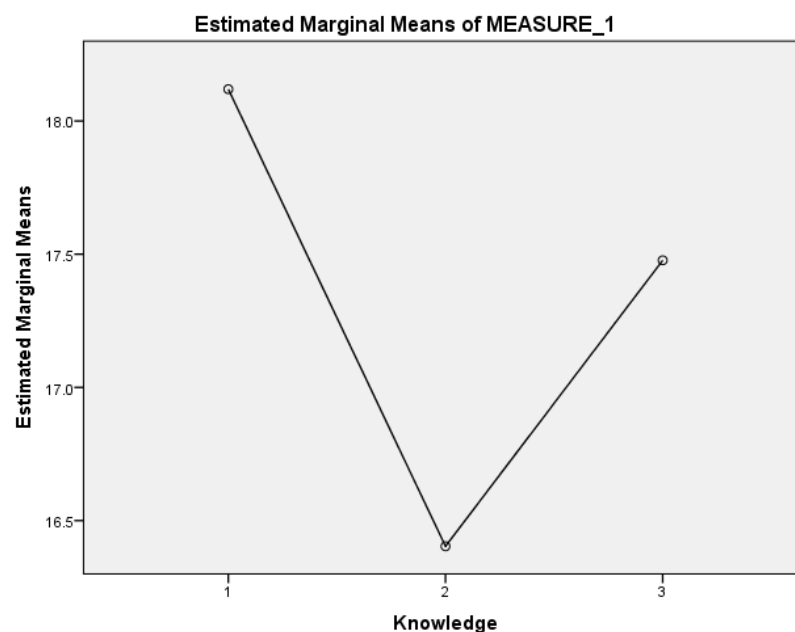
*Greenhouse-Geisser*

$F= 1.31$  ( $df= 1.01, 109.48$ ) ,  $P$  value  $<0.001$

The results of repeated measures ANOVA, indicated that the knowledge levels of participants in the control group were affected over time ( $F(1.33, 143.16)=7.977$ ,  $p=0.002$ ). The differences in the mean scores were statistically significant, so the null hypothesis was rejected. There was a significant change in knowledge over time for the control group.

Figure 14 shows the unweighted means of knowledge for the control group calculated to control for the effect of other variables. The plotted results show that the level of knowledge of the experimental group decreased significantly at the post-test stage but subsequently significantly increased by the post-test 2 stage. The final level of knowledge ended at a point lower than at the beginning.

**Figure 14: Mean Plot of Knowledge Scores for the Control Group**



#### **RESEARCH QUESTION 7**

**Do primary school teachers' knowledge about children with T1DM change over time without receiving the health education programme intervention?**

The knowledge level of participants in the control group fluctuated over time. It decreased from the pre-test stage (18.12) to the post-test stage (16.40), and then increased from the post-test to the post-test 2 stage (17.48). The conclusion that can be drawn from these results was that primary school teachers' knowledge levels of

T1DM management in school children fluctuated from the post-test stage to the post-test 2 stage.

## RESEARCH QUESTION 8

### **Do primary school teachers' knowledge about children with T1DM change over time following the health education programme intervention?**

The knowledge levels of participants in the experimental group significantly increased over time from pre-test (Mean=15.18), to post-test (Mean=29.85), and on to post-test 2 (Mean=32.93). There was an increase of 14.67 at the post-test stage which equated to a 96.64% increase. There was an increase of 17.75 at the post-test 2 stage which equated to a 116.93% improvement. The differences in these mean scores were found to be statistically significant at both the post-test and post-test 2 stages. The conclusion that can be drawn from these results is that primary school teachers in the experimental group had significantly improved their knowledge of T1DM management in school children following the health education programme intervention over time.

## **Attitude Levels for the Experimental Group**

Table 18 shows that the participants in the experimental group had the highest attitude scores at the post-test stage (3 three months) ( $M=85.14$ ,  $SD=10.338$ ) and the lowest scores at the onset of the study ( $M=80.52$ ,  $SD=12.957$ ). The 4.62 increase in the mean score at the post-test stage represented an increase of 5.74%, and the 3.74 increase in the mean score at the post-test 2 stage represented an increase of 4.64%. The results of Mauchly's test were significant,  $X^2(2)=143.666$ ,  $p<.001$ , which violated the assumption of sphericity. Therefore the Greenhouse-Geisser corrected value of F was used to determine significance.

**Table 18: Repeated Attitude Statistics for the Experimental Group**

Attitude test scores	N	mean $\pm$ SD
Pre-test	209	80.52 $\pm$ 12.96
Post-test	209	85.14 $\pm$ 10.34
Post-test 2	209	84.26 $\pm$ 10.18

*Greenhouse-Geisser*

$F= 36.07$  ( $df= 1.33, 277.25$ ),  $P$  value  $<0.001$

The results of repeated measures ANOVA indicated that the attitude levels of participants in the experimental group were affected over time ( $F(1.33, 277.251)=36.071$ ,  $p<.001$ ). The differences in the mean scores were statistically significant, so the null hypothesis was rejected. There was a significant change in attitude over time in the experimental group.

**Figure 15: Mean Plot of Attitude Scores for the Experimental Group**

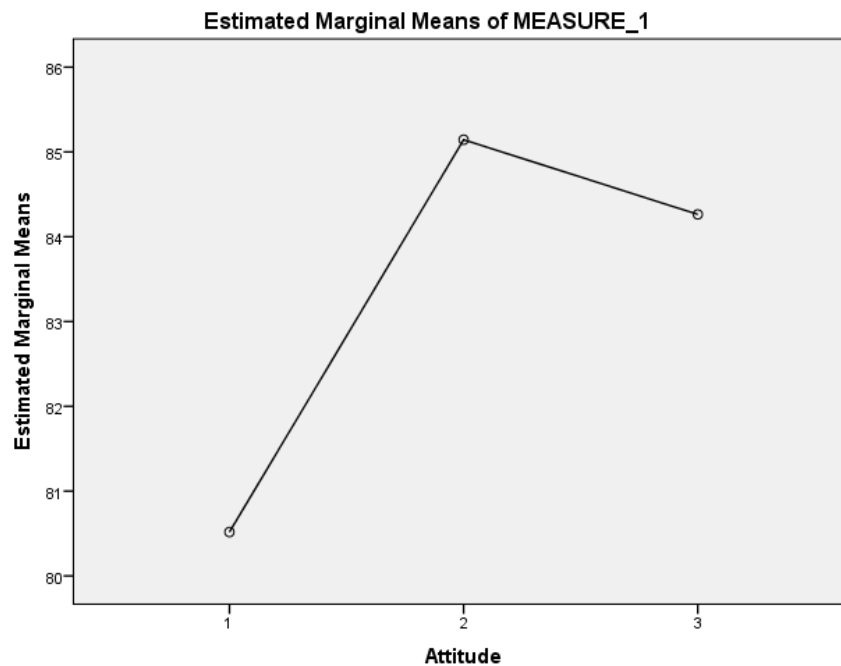


Figure 15 shows the unweighted means of attitude for the experimental group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of attitude significantly increased up until the post-test stage and decreased slightly following the post-test stage and up until the post-test 2 stage, though remaining much improved on the pre-test score.

### **Attitude Levels for the Control Group**

Participants in the control group had slightly higher attitude scores at the post-test 2 stage (6 months) ( $M=81.46$ ,  $SD=12.237$ ) than they did at the onset of the study ( $M=80.07$ ,  $SD=10.588$ ) (Table 19). The increase of 1.32 at the post-test stage represented an increase of 1.65%, and the increase of 1.39 at the post-test 2 stage represented an increase of 1.74%. The results of Mauchly's test were significant ( $\chi^2(2) = 386.307$ ,  $p<.001$ ), which violated the assumption of sphericity. Therefore the Greenhouse-Geisser corrected value of  $F$  was used to determine significance.



**Table 19: Repeated Attitude Statistics for the Control Group**

Attitude test scores	N	mean $\pm$ SD
Pre-test	109	80.07 $\pm$ 10.59
Post-test	109	81.39 $\pm$ 12.14
Post-test 2	109	81.46 $\pm$ 12.24

*Greenhouse-Geisser*  
 $F = 1.31$  ( $df = 1.01, 109.48$ ),  $P$  value  $< 0.001$

The results of repeated measures ANOVA indicated that the knowledge levels of participants in the experimental group were affected over time ( $F(1.01, 109.480) = 1.315$ ,  $p = .26$ ). The differences in the mean scores were not statistically significant, so the null hypothesis was retained. There was no significant change in attitude over time in the control group. Although there was an increase in the mean attitude score at both the post-test and post-test 2 stages, this increase was within a tolerated level of variance and was not statistically significant.

**Figure 16: Mean Plot of Attitude Scores for the Control Group**

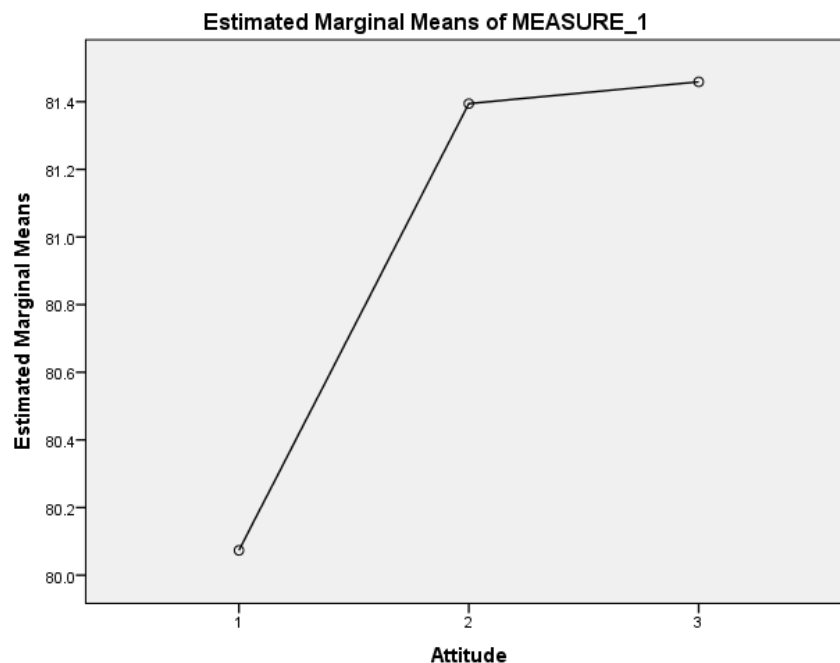


Figure 16 shows the unweighted means of attitude for the control group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of attitude significantly increased up until the post-test stage (2) and increased slightly following the post-test stage and up until the post-test 2 stage (3).

#### **RESEARCH QUESTION 9**

**Do primary school teachers' attitudes towards children with T1DM change over time following the health education programme intervention?**

The attitude levels of participants in the experimental group fluctuated over time. The score levels improved from the pre-test stage (80.52) to the post-test stage (85.14), and then slightly decreased from the post-test stage to the post-test 2 stage (84.26). Overall, there was still a significant change in school teachers' attitudes at both the post-test and post-test 2 stages. The conclusion that can be drawn for these results was that primary school teachers' attitudes towards school children with T1DM significantly improved following the health education programme intervention.

#### **RESEARCH QUESTION 10**

**Do primary school teachers' attitudes towards children with T1DM change over time without receiving the health education programme intervention?**

The attitude levels of participants in the control group gradually increased over time from the pre-test stage (80.07), to the post-test stage (81.39), and through to the post-test 2 stage (81.46). However, both these increases were found not to be statistically significant and it was accepted that these increases were within a tolerated level of variance. The conclusion that can be drawn from these results is that there was no significant change in primary school teachers' attitudes towards school children with T1DM over time in the control group.

#### **DIFFERENCES BETWEEN DEMOGRAPHIC CATEGORIES IN RELATION TO THE STUDY VARIABLES**

This section presents the results obtained from comparisons made between each demographic category (gender, age, and education) with regards to the study variables (knowledge and attitudes). The findings were based solely on the experimental group which consisted of 209 participants. Comparisons were also made on the value of parametric statistics using a series of one-way between-subject ANOVA tests.

## Knowledge Pre-test and Gender

There were more males ( $n=117$ ) than females ( $n=92$ ) in the experimental group, and females scored slightly higher at the knowledge pre-test stage ( $M=15.86$ ,  $SD=16.302$ ) than males ( $M=14.64$ ,  $SD=17.355$ ). The distribution of knowledge pre-test scores for the experimental group was slightly non-normal. The measures of central tendency were not close in range, and the kurtosis value exceeded the recommended  $\pm 2.00$  by  $0.116$  (Lomax & Hahs-Vaughn, 2012). Nevertheless, Lomax & Hahs-Vaughn (2012, p.90) state that:

There are different rules of thumb for determining how extreme kurtosis can be and still retain a relatively normal distribution. One simple rule of thumb is that kurtosis values within  $\pm 2.0$  are considered relatively normal, with more conservative researchers applying a  $\pm 3.0$  guideline.

It was therefore accepted that the excess of  $0.116$  above the recommended kurtosis level of  $\pm 2.00$  was not such that the distribution should be considered non-normal and steps should be taken to rectify the data, or to consider the use of non-parametric testing methods. The variances between the groups were equal since the results of Levene's test were not significant ( $p=.98$ ). This assumption of ANOVA had not been violated. The results of the one-way ANOVA were not statistically significant ( $F(1, 207)=.267$ ,  $p=.61$ ) (Table 20) therefore, the null hypothesis was retained. There were no statistically significant differences between genders based on their knowledge pre-test scores.

**Table 20: Comparison of Gender and Knowledge Pre-test Scores**

Gender	n	Pre-test knowledge scores mean $\pm$ SD
Male	117	14.64 $\pm$ 17.35
Female	92	15.86 $\pm$ 16.30
<b>Total</b>	209	15.18 $\pm$ 16.87
<i>One way ANOVA <math>F(1, 207)=0.27</math>, <math>p=0.61</math></i>		

## Knowledge Pre-test and Age

Table 21 shows that the largest age group was the 35 to 44 year-olds ( $n=87$ ) and the smallest age group was the 55 or older ( $n=27$ ). Participants in the 45 to 54 year-old age group had the highest knowledge pre-test scores ( $M=18.14$ ,  $SD=18.926$ ) and participants in the 55 or older age group had the lowest scores ( $M=12.22$ ,  $SD=10.591$ ).

**Table 21: Age Group and Knowledge Pre-test**

Age Groups	N	Pre-test knowledge test scores mean $\pm$ SD
25 – 34	58	13.31 $\pm$ 15.16
35 – 44	87	16.08 $\pm$ 18.51
45 – 54	37	18.14 $\pm$ 18.93
55 or older	27	12.22 $\pm$ 10.59
<b>Total</b>	209	15.18 $\pm$ 16.87

*One way ANOVA  $F(3, 205)=0.97$ ,  $p=0.41$*

The variance between the age groups were equal, since the results of Levene's test were not significant ( $p=.06$ ); therefore the assumption of homogeneity had not been violated). The results of the one-way ANOVA were not significant ( $F(3, 205)=.975$ ,  $p=.41$ ), therefore the null hypothesis was retained. There were no statistically significant differences between the age groups based on their knowledge pre-test scores.

## Knowledge Pre-test and Education

Table 22 shows that there were more participants with bachelor degrees ( $n=186$ ) than high school diplomas ( $n=19$ ) or post-graduate degrees ( $n=4$ ). In addition, it reveals that the participants with post-graduate degrees had the highest knowledge pre-test scores ( $M=33.00$ ,  $SD=32.599$ ) and participants with bachelor degrees had the lowest scores ( $M=14.16$ ,  $SD=15.810$ ). It was seen previously that participants in the 45 to 54 year-old age group had the highest knowledge pre-test scores and this might tend to indicate that those participants which had acquired a great deal of professional experience were more likely to have higher levels of knowledge. It is difficult to compare levels of education between the participants with a diploma, and those with a Bachelor's degree.

This is because there was only a small group of participants with a diploma (n=19) and a very large group of participants with a Bachelor's degree (n=186). So the lower mean scores in the Bachelor's degree group might simply be attributed to a number of individuals who had very low knowledge scores and therefore diluted the mean score for the group further. Nevertheless, it is interesting to note that the postgraduate participants showed significantly higher scores than those participants with a diploma or Bachelor's degree. It might be the case that education correlates with knowledge at the postgraduate level, but the small number of postgraduates prevents any further interpretation.

**Table 22: Education and Knowledge Pre-test**

Level of Education	n	Pre-test knowledge test scores mean $\pm$ SD
Diploma	19	21.42 $\pm$ 20.49
Bachelor	186	14.16 $\pm$ 15.18
Postgraduate	4	33 $\pm$ 32.6
<b>Total</b>	209	15.18 $\pm$ 16.87
<i>Welch's ANOVAF (2, 7.025)=1.61, p=0.27</i>		

The results of the Levene's test were significant ( $p=.001$ ) which indicated that the variances between the groups were not equal. This violated the homogeneity assumption of ANOVA. Consequently Welch's ANOVA was used as an alternative to test for significant differences between the groups. The results of Welch's ANOVA were not significant ( $F(2, 7.025)=1.609, p=.27$ ), therefore, the null hypothesis was retained. There were no statistically significant differences between the education groups based on their knowledge pre-test scores.

#### **RESEARCH QUESTION 11**

**What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' knowledge (experimental group) pre-test scores?**

##### ***Gender***

Females had higher pre-test knowledge scores (Mean=15.86) than males (Mean=14.64) but the distribution of males and females in the experimental group

was not equal, (Male=117, Female=92). The difference in the pre-test knowledge score was found to be not statistically significant. The conclusion that can be drawn from these results was that primary school teachers' prior knowledge of T1DM management in school children was not affected by gender.

### **Age Group**

The participants who were 45 to 54 years-old has the highest knowledge pre-test scores (Mean=18.14). The 35 to 44 years-old group had the next highest knowledge pre-test scores (Mean=16.08). The participants in the 55 years-old or older group had the lowest knowledge pre-test scores (Mean=12.22). However, it was found that these differences in mean scores in the different age groups were not statistically significant. Age group did not impact significantly on primary school teachers' knowledge of T1DM management in school children.

### **Level of Education**

Participants with bachelor degrees had the lowest knowledge pre-test scores (Mean=14.16), while participants with high school diplomas had higher scores (Mean=21.42) and participants with post-graduate degrees showed the highest level of knowledge pre-test scores (Mean=33.00). However it was found that there were no statistically significant differences between the education groups based on their knowledge pre-test scores. Level of education did not impact significantly on primary school teachers' knowledge of T1DM management in school children.

### **Attitude Pre-test and Gender**

Table 23 indicates that male participants had higher attitude pre-test scores ( $M=84.06$ ,  $SD=12.251$ ) than females ( $M=76.01$ ,  $SD=12.480$ ).

**Table 23: Gender and Attitude Pre-test**

Gender	n	Pre-test Attitude scores mean $\pm$ SD
Male	117	84.06 $\pm$ 12.25
Female	92	76.01 $\pm$ 12.48
<b>Total</b>	209	80.52 $\pm$ 12.96
<i>One way ANOVA <math>F(1, 207)=21.868</math>, <math>p&lt;.001</math></i>		

The distribution of attitude pre-test scores for the experimental group was close in range, and the skewness and kurtosis were also both within acceptable levels. The variances between the group were equal, since the results of Levene's test were not significant ( $p=.52$ ). The assumption of homogeneity had not been violated. The results of the one-way ANOVA were statistically significant ( $F(1, 207)=21.868$ ,  $p<.001$ ). It was found that gender significantly affected the pre-test attitudes of the participants.

### Attitude Pre-test and Age

Table 24 indicates that the 35 to 44 year-old age group had the highest attitude pre-test scores ( $M=82.51$ ,  $SD=13.531$ ), and this group was closely followed by the 45 to 54 year-old age group ( $M=82.11$ ,  $SD=12.801$ ). The 55 or older age group had the lowest attitude pre-test scores ( $M=74.70$ ,  $SD=10.720$ ), but the 25 to 34 year-old age group scored slightly better ( $M=79.22$ ,  $SD=12.453$ ).

**Table 24: Age Group and Attitude Pre-test**

Age Groups	N	Pre-test Attitude scores mean $\pm$ SD
25 – 34	58	79.22 $\pm$ 12.45
35 – 44	87	82.51 $\pm$ 13.53
45 – 54	37	82.11 $\pm$ 12.80
55 or older	27	74.70 $\pm$ 10.72
<b>Total</b>	<b>209</b>	80.52 $\pm$ 12.96
<i>One way ANOVA <math>F(3, 205)=2.954</math>, <math>p=0.03</math></i>		

The results of the Levene's test were not significant ( $p=.14$ ) so the assumption of homogeneity had not been violated. The results of the one-way ANOVA were statistically significant ( $F(3, 205)=2.954$ ,  $p=.03$ ). Consequently, age group had a statistically significant impact on the attitudes of the participants towards children with T1DM at the pre-test stage. The 35-44 and 45-54 age groups had the highest attitude pre-test scores and the 55 or older had the lowest attitude pre-test scores. Table 25 demonstrates the results of Tukey's *post hoc* comparison test, showing that the 35 to 44 years-olds' attitude pre-test scores differed significantly from the 55 or older age group. The mean difference was 7.80,  $p=.03$ .

**Table 25: Tukey's Post Hoc Comparison of Age Group and Attitude Pre-test**

Age	Age	Mean	95% Confidence Interval		Sig.
		Attitude Difference	Lower Bound	Upper Bound	
25-34	35-44	-3.28	-8.89	2.33	0.43
	45-54	-2.88	-9.85	4.08	0.707
	55 or older	4.52	-3.19	12.23	0.428
35-44	25-34	3.28	-2.33	8.89	0.43
	45-54	0.4	-6.1	6.89	0.999
	55 or older	7.80 <sup>*</sup>	0.51	15.09	<b>0.031</b>
45-54	25-34	2.88	-4.08	9.85	0.707
	35-44	-0.4	-6.89	6.1	0.999
	55 or older	7.4	-0.97	15.78	0.104
55 or older	25-34	-4.52	-12.23	3.19	0.428
	35-44	-7.80 <sup>*</sup>	-15.09	-0.51	<b>0.031</b>
	45-54	-7.4	-15.78	0.97	0.104

### Attitude Pre-test and Education

Table 26 shows that participants with post-graduate degrees had the highest attitude pre-test scores ( $M=93.75$ ,  $SD=20.370$ ), and participants with bachelor degrees had the lowest scores ( $M=79.69$ ,  $SD=12.635$ ).

**Table 26: Education and Attitude Pre-test**

Level of Education	N	Pre-test Attitude scores mean $\pm$ SD
Diploma	19	85.79 $\pm$ 12.44
Bachelor	186	79.69 $\pm$ 12.63
Postgraduate	4	93.75 $\pm$ 20.37
<b>Total</b>	<b>209</b>	80.52 $\pm$ 12.96

*One way ANOVA  $F(2, 206)=4.16$ ,  $p=0.017$*

The variance between the groups was equal, since the result of Levene's test were not significant  $p=.12$ . The assumption of homogeneity had not been violated. The results of the one-way ANOVA were statistically significant ( $F(2, 206)=4.157$ ,  $p=.02$ ). The level of education of the participants exerted a statistically significant impact on the attitudes of school teachers towards children with T1DM.



## **RESEARCH QUESTION 12**

**What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' attitude (experimental group) pre-test scores?**

### ***Gender***

Males had higher pre-test attitude scores (Mean=84.06) than females (Mean=76.01), and the difference in these scores was found to be statistically significant. Males had more positive attitudes towards children with T1DM than females prior to their participation in the health education programme intervention.

### ***Age Group***

The participants who were 35 to 44 years-old (Mean=82.51) and 45 to 54 years-old (Mean=82.11) had highest attitude pre-test scores, while participants who were 25 to 34 years-old (Mean=79.22) and 55 years-old or older (Mean=74.70) had the lowest scores. The differences in these scores were found to be statistically significant. Prior to their participation in the health education programme participants aged 35 to 54 years had more positive attitudes towards children with T1DM than participants who were aged 25 to 34 or aged 55 years-old or older.

### ***Level of Education***

Participants with a post-graduate degree had the highest attitude pre-test scores (Mean=93.75) than those with bachelor degrees (Mean=85.79) and high school diplomas (Mean=79.69). The differences were found to be statistically significant. The conclusion that can be drawn from these results is that prior to their participation in the health education intervention participants with post-graduate degrees had more positive attitudes towards children with T1DM than those with bachelor degrees and high school diplomas.

## **Knowledge Post-test and Gender**

The distribution of knowledge post-test scores for the experimental group only was close in range, and the skewness and kurtosis were within acceptable recommended levels. The female participants had higher knowledge at post-test ( $M=32.72$ ,

$SD=13.383$ ) than males ( $M=27.60$ ,  $SD=12.779$ ) (Table 27). The results of Levene's test were not significant ( $p=.22$ ), therefore the assumption of homogeneity had not been violated.

**Table 27: Gender and Knowledge Post-test**

Gender	N	Post-test knowledge scores mean $\pm$ SD
Male	117	27.6 $\pm$ 12.78
Female	92	32.72 $\pm$ 13.38
Total	209	29.85 $\pm$ 13.26

*One way ANOVA  $F(1, 207)=7.93$ ,  $p=0.005$*

The results of the one-way ANOVA were statistically significant ( $F(1, 207)=7.928$ ,  $p=.01$ ). Gender exerted a significant difference on the experimental group's knowledge at the post-test stage and females demonstrated higher levels of knowledge at the post-test stage than males.

**Figure 17: Mean Plot of Gender and Knowledge Post-test Scores**

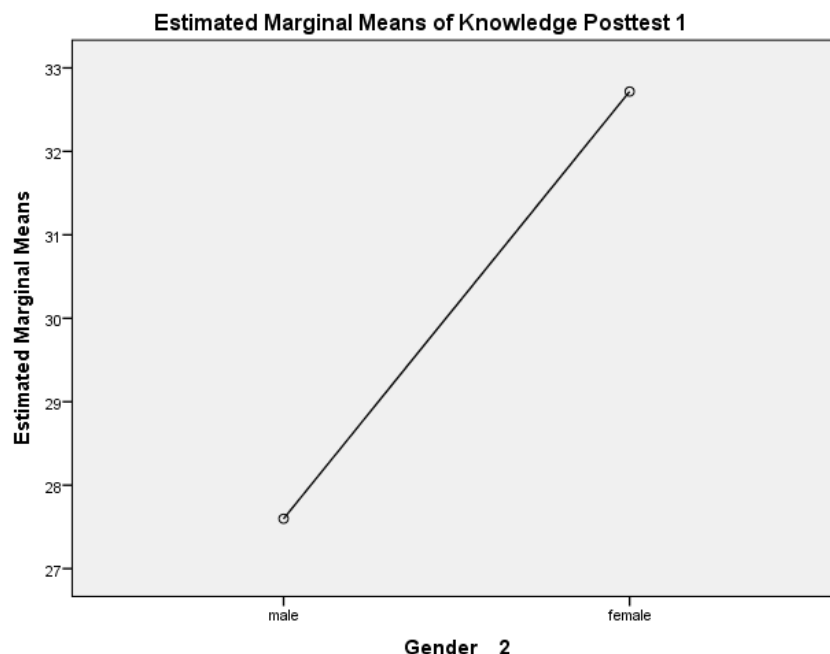


Figure 17 shows the unweighted means of knowledge scores at the post-test stage for the experimental group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of knowledge were

significantly higher for females than for males, and that there would seem to be a relationship between gender and knowledge at the post-test stage.

### Knowledge Post-test and Age Group

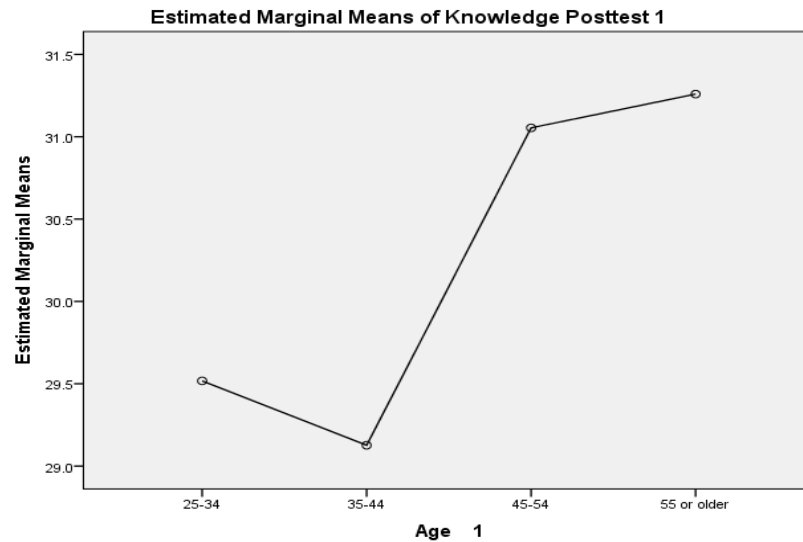
Table 28 indicates that the 55 or older age group had the highest knowledge post-test scores ( $M=31.26$ ,  $SD=13.008$ ), and this group was closely followed by the 45 to 54 year-old age group ( $M=31.05$ ,  $SD=13.884$ ). The 35 to 44 year-old age group had the lowest knowledge post-test scores ( $M=29.13$ ,  $SD=13.106$ ), but the 25 to 34 year-old age group scored slightly higher ( $M=29.52$ ,  $SD=13.456$ ). The results of Levene's test were not significant ( $p=.53$ ). Consequently, the assumption of homogeneity had not been violated. The results of the one-way ANOVA were not statistically significant ( $F(3, 205)=.299$ ,  $p=.83$ ). Consequently, age exerted no significant difference on the experimental group's knowledge at the post-test stage.

**Table 28: Age Group and Knowledge Post-test**

Age Groups	N	Post-test knowledge scores mean $\pm$ SD
25 – 34	58	29.52 $\pm$ 13.46
35 – 44	87	29.13 $\pm$ 13.11
45 – 54	37	31.05 $\pm$ 13.88
55 or older	27	31.26 $\pm$ 13.01
<b>Total</b>	<b>209</b>	29.85 $\pm$ 13.26
<i>One way ANOVA <math>F(3, 205)= 0.299</math>, <math>p=0.826</math></i>		

Figure 18 shows the unweighted means of knowledge for the experimental group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of knowledge were higher for the 45-54 and 55 or older age groups compared to the 25-34 and the 35-44 age groups at the post-test stage.

**Figure 18: Mean Plot of Age Group and Knowledge Post-test Scores**



### Knowledge Post-test and Education

Table 29 shows that participants with post-graduate degrees had the highest knowledge post-test scores ( $M=42.00$ ,  $SD=20.067$ ), and participants with bachelor degrees had the lowest scores ( $M=29.20$ ,  $SD=12.831$ ). The results of Levene's test were not significant,  $p=.17$ , so the assumption of homogeneity had not been violated. The results of the one-way ANOVA were not statistically significant ( $F(2, 206)=2.741$ ,  $p=.07$ ), so it was found that education level exerted no significant difference on the experimental group's knowledge at the post-test stage.

**Table 29: Education and Knowledge Post-test**

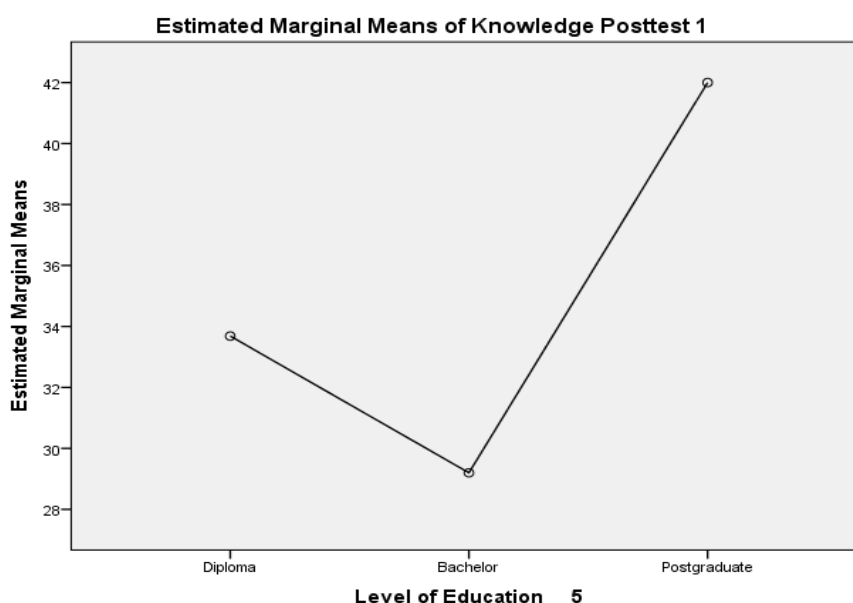
Level of Education	N	Post-test knowledge scores mean $\pm$ SD
Diploma	19	33.68 $\pm$ 14.87
Bachelor	186	29.2 $\pm$ 12.83
Postgraduate	4	42 $\pm$ 20.07
<b>Total</b>	<b>209</b>	29.85 $\pm$ 13.26

*One way ANOVA  $F(2, 206)= 2.74$ ,  $p=0.067$*

Figure 19 shows the unweighted means of knowledge for the experimental group calculated to control for the effect of other variables. The plotted results show that the

estimated marginal means of knowledge were significantly higher for participants with postgraduate qualifications compared to those with diplomas or bachelor's degrees.

**Figure 19: Mean Plot of Education and Knowledge Post-test Scores**



### RESEARCH QUESTION 13

**What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' knowledge (experimental group) post-test scores?**

#### **Gender**

Females had higher knowledge post-test scores (Mean=32.72) than males (Mean=27.60), and the difference in these scores was found to be statistically significant. The conclusion that can be drawn from these results is that the health education programme intervention affected females more positively than it did males at the post-test stage.

#### **Age Group**

The participants who were 55 or older (Mean=31.26) and 45 to 54 years-old (Mean=31.05) had highest knowledge post-test scores, while participants who were 25 to 34 years-old (Mean=29.52) and 35 to 44 years-old (Mean=29.13) had the lowest scores. These differences between the age groups were found not to be statistically significant. The age of the participants in the experimental group did not affect their knowledge about children with T1DM at the post-test stage.

### **Level of Education**

Participants with a post-graduate degree in the experimental group had the highest post-test knowledge scores (mean=42.00). Those participants with high school diplomas showed the next highest level of knowledge (Mean=33.68) and those participants with bachelor degrees showed the lowest level of knowledge (Mean=29.20). The differences in these scores were not found to be statistically significant. The level of education of the participants in the experimental group did not affect their knowledge about children with T1DM at the post-test stage.

### **Attitude Post-test and Gender**

The distribution of knowledge post-test scores for the experimental group was close in range, and the skewness and kurtosis values were acceptable, since they did not exceed  $\pm 2.00$  (Lomax & Hahs-Vaughn, 2012). Table 30 reveals that male participants had higher attitude post-test scores ( $M=87.38$ ,  $SD=10.014$ ) than females ( $M=82.29$ ,  $SD=10.088$ ).

**Table 30: Gender and Attitude Post-test**

Gender	N	Post-test Attitude scores mean $\pm$ SD
Male	117	87.38 $\pm$ 10.01
Female	92	82.29 $\pm$ 10.09
<b>Total</b>	<b>209</b>	85.14 $\pm$ 10.34

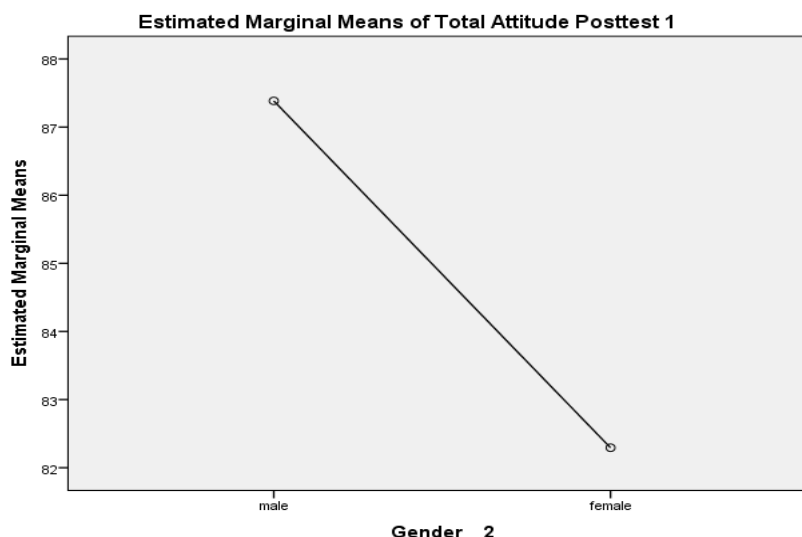
*One way ANOVA  $F(1, 207)=13.226$ ,  $p<.001$*

The results of Levene's test were not significant,  $p=.995$ , so the assumption of homogeneity had not been violated. The results of the one-way ANOVA were statistically significant ( $F(1, 207)=13.226$ ,  $p<.001$ ), and it was found that gender exerted a significant difference on the experimental group's attitudes towards children with T1DM at the post-test stage. Males demonstrated more positive attitudes towards children with T1DM than females.

Figure 20 shows the unweighted means of attitude scores at the post-test stage for the experimental group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of attitude were significantly

higher for males than for males, and that there would seem to be a relationship between gender and attitudes at the post-test stage.

**Figure 20: Mean Plot of Gender and Attitude Post-test Scores**



### Attitude Post-test and Age Group

Table 31 indicates that the 35 to 44 year-old age group had the highest attitude post-test scores ( $M=86.52$ ,  $SD=10.858$ ), and were closely followed by the 45 to 54 year-old age group ( $M=86.24$ ,  $SD=11.288$ ). In contrast, the 55 or older age group had the lowest attitude post-test scores ( $M=81.93$ ,  $SD=7.447$ ). The results of Levene's test were not significant ( $p=.06$ ), and assumption of homogeneity had not been violated. The results of the one-way ANOVA were not statistically significant ( $F(3, 205)=1.835$ ,  $p=.14$ ). Therefore, it was found that the age of the participants in the experimental group exerted no significant difference on the experimental group's attitudes at the post-test stage.

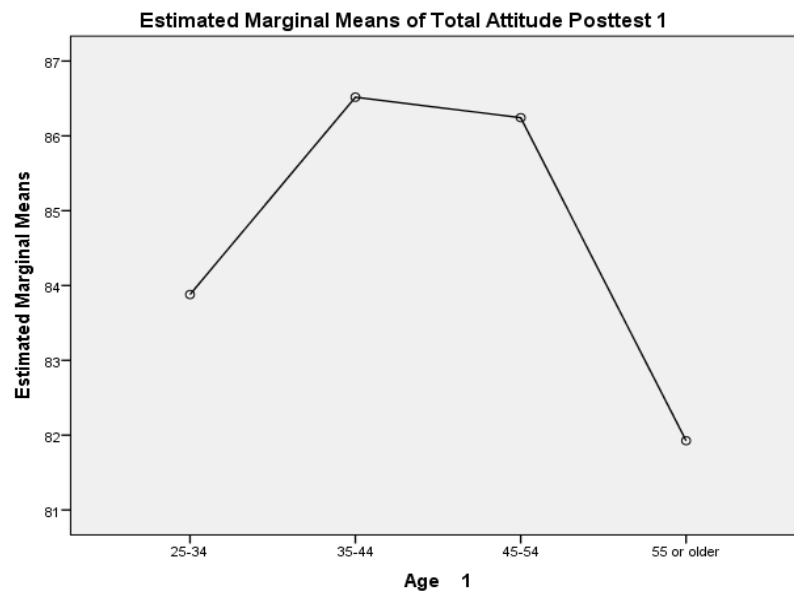
**Table 31: Age Group and Attitude Post-test**

Age Groups	N	Post-test Attitude scores mean $\pm$ SD
25 – 34	58	83.88 $\pm$ 9.80
35 – 44	87	86.52 $\pm$ 10.86
45 – 54	37	86.24 $\pm$ 11.29
55 or older	27	81.93 $\pm$ 7.45
<b>Total</b>	<b>209</b>	85.14 $\pm$ 10.34

One way ANOVA  $F(3, 205)=1.835$ ,  $p=0.142$

Figure 21 shows the unweighted means of attitude for the experimental group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of attitude were higher for the 35-44 and 45-54 age groups compared to the 25-34 and 55 or older age groups.

**Figure 21: Mean Plot of Age Group and Attitude Post-test Scores**



### Attitude Post-test and Education

Participants with post-graduate degrees had the highest attitude post-test scores ( $M=96.00$ ,  $SD=16.391$ ), and participants with bachelor degrees had the lowest scores ( $M=84.35$ ,  $SD=10.046$ ). The results of Levene's test were not significant ( $p=.14$ ), so the assumption of homogeneity had not been violated. The results of the one-way ANOVA were statistically significant ( $F(2, 206)=5.612$ ,  $p=.004$ ). Therefore, it was found that the education level of the participants in the experimental group exerted a significant difference on the experimental group's attitudes towards children with T1DM at the post-test stage. Those participants with a postgraduate degree show significantly higher positive attitudes towards children with T1DM than those with participants with a diploma or a bachelor's degree, as shown in Table 32.



**Table 32: Education and Attitude Post-test**

Level of Education	N	Post-test Attitude scores mean $\pm$ SD
Diploma	19	90.58 $\pm$ 9.44
Bachelor	186	84.35 $\pm$ 10.05
Postgraduate	4	96 $\pm$ 16.39
<b>Total</b>	<b>209</b>	<b>85.14 <math>\pm</math> 10.34</b>

*One way ANOVA  $F(2, 206) = 5.61, p = 0.004$*

**Figure 22: Mean Plot of Education and Attitude Post-test Scores**

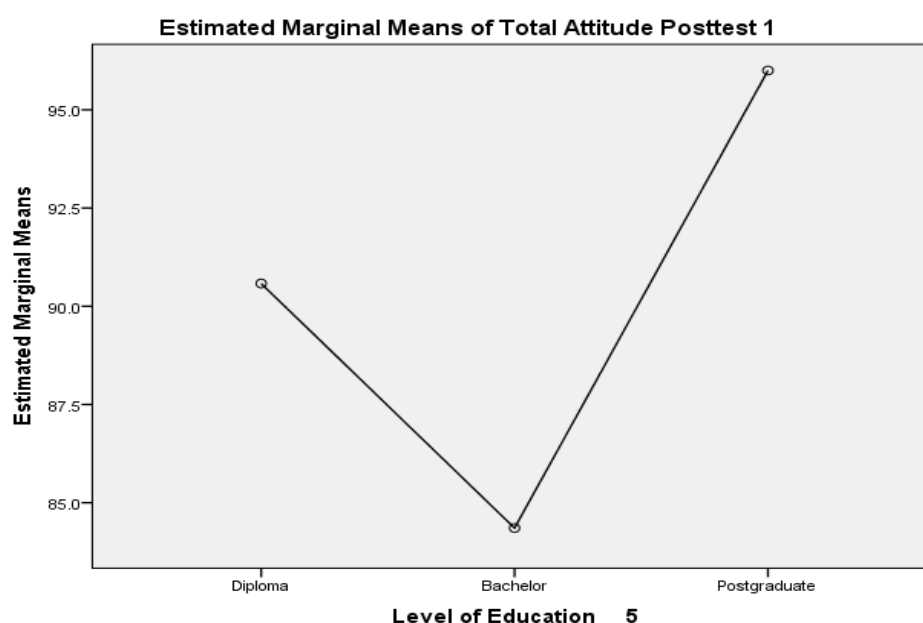


Figure 22 shows the unweighted means of attitude for the experimental group calculated to control for the effect of other variables. The plotted results show that the estimated marginal means of attitude were significantly higher for participants with a postgraduate qualification compared to those participants with a diploma or a bachelor's degree.

#### **RESEARCH QUESTION 14**

**What impact do socio-demographic factors (gender, age group, level of education) have on primary school teachers' attitude (experimental group) post-test scores?**

##### ***Gender***

Males showed higher attitude scores (Mean=87.38) than females (Mean=82.29) at

the post-test stage. The difference in these scores was found to be statistically significant. Male teachers demonstrated significantly more positive attitudes towards children with T1DM than female teachers at the post-test stage.

### ***Age Group***

The participants who were in the 35 to 44 years-old (Mean=86.52) and 45 to 54 years-old (Mean=86.24) age groups had the highest post-test attitude scores. Participants who were 25 to 34 years-old (Mean=83.88) and 55 years-old or older (Mean=81.93) had the lowest scores. The differences in the attitude scores were found not to be statistically significant, so age did not affect the attitudes of the participants towards children with T1DM at the post-test stage.

### ***Level of Education***

Participants with a post-graduate qualification showed the highest attitude post-test scores (Mean=96.00) than those with bachelor degrees (Mean=84.35) and high school diplomas (Mean=90.58). The differences in these scores were found to be statistically significant. Participants with post-graduate qualification showed significantly higher positive attitudes towards children with T1DM than those with a diploma or bachelor's degree after the intervention.

## **SUMMARY OF FINDINGS**

The following tables group together and summarise the findings from the results cited throughout this chapter to allow for easier comparison. The tables also summarise whether or not there were statistical differences between the results that were found.

**Table 33: Summary of Knowledge Scores for Experimental and Control Groups**

<b>Knowledge test scores</b>	<b>Experimental group</b>		<b>Control group</b>	
	<b>N</b>	<b>mean <math>\pm</math> SD</b>	<b>n</b>	<b>mean <math>\pm</math> SD</b>
Pre-test	209	15.18 $\pm$ 16.87	109	18.12 $\pm$ 19.83
Post-test	209	29.85 $\pm$ 13.26	109	16.4 $\pm$ 17.67
Post-test 2	209	32.93 $\pm$ 14.10	109	17.48 $\pm$ 19.31
Differences Statistically Significant?	Yes		Yes	

**Table 34: Summary of Attitude Scores for Experimental and Control Groups**

Attitude test scores	Experimental group		Control group	
	n	mean $\pm$ SD	n	mean $\pm$ SD
Pre-test	209	80.52 $\pm$ 12.96	109	80.07 $\pm$ 10.59
Post-test	209	85.14 $\pm$ 10.34	109	81.39 $\pm$ 12.14
Post-test 2	209	84.26 $\pm$ 10.18	109	81.46 $\pm$ 12.24
Differences Statistically Significant?	Yes		No	

**Table 35: Summary of Experimental Group Knowledge Scores by Gender**

Knowledge scores	N	Male mean $\pm$ SD	N	Female mean $\pm$ SD	Differences Statistically Significant?
Pre-test	117	14.64 $\pm$ 17.35	92	15.86 $\pm$ 16.30	No
Post-test	117	27.6 $\pm$ 12.78	92	32.72 $\pm$ 13.38	Yes

**Table 36: Summary of Experimental Group Attitude Scores by Gender**

Attitude scores	N	Male mean $\pm$ SD	N	Female mean $\pm$ SD	Differences Statistically Significant?
Pre-test	117	84.06 $\pm$ 12.25	92	76.01 $\pm$ 12.48	Yes
Post-test	117	87.38 $\pm$ 10.01	92	82.29 $\pm$ 10.09	Yes

**Table 37: Summary of Experimental Group Knowledge Scores by Age**

Knowledge scores	25 - 34 mean $\pm$ SD (n=58)	35 - 44 mean $\pm$ SD (n=87)	45 - 54 mean $\pm$ SD (37)	55 or Older mean $\pm$ SD (n=27)	Differences Statistically Significant?
Pre-test	13.31 $\pm$ 15.16	16.08 $\pm$ 18.51	18.14 $\pm$ 18.93	12.22 $\pm$ 10.59	No
Post-test	29.52 $\pm$ 13.46	29.13 $\pm$ 13.11	31.05 $\pm$ 13.88	31.26 $\pm$ 13.01	No

**Table 38: Summary of Experimental Group Attitude Scores by Age**

Attitude scores	25 - 34 mean $\pm$ SD (n=58)	35 - 44 mean $\pm$ SD (n=87)	45 - 54 mean $\pm$ SD (37)	55 or Older mean $\pm$ SD (n=27)	Differences Statistically Significant?
Pre-test	79.22 $\pm$ 12.45	82.51 $\pm$ 13.53	82.11 $\pm$ 12.80	74.70 $\pm$ 10.72	Yes
Post-test	83.88 $\pm$ 9.80	86.52 $\pm$ 10.86	86.24 $\pm$ 11.29	81.93 $\pm$ 7.45	No

**Table 39: Summary of Experimental Group Knowledge Scores by Level of Education**

<b>Knowledge scores</b>	<b>Diploma mean <math>\pm</math> SD (n=19)</b>	<b>Bachelor mean <math>\pm</math> SD (n=186)</b>	<b>Postgraduate mean <math>\pm</math> SD (n=4)</b>	<b>Differences Statistically Significant?</b>
Pre-test	21.42 $\pm$ 20.49	14.16 $\pm$ 15.18	33.00 $\pm$ 32.60	No
Post-test	33.68 $\pm$ 14.87	29.20 $\pm$ 12.83	42.00 $\pm$ 20.07	No

**Table 40: Summary of Experimental Group Attitude Scores by Level of Education**

<b>Attitude scores</b>	<b>Diploma mean <math>\pm</math> SD (n=19)</b>	<b>Bachelor mean <math>\pm</math> SD (n=186)</b>	<b>Postgraduate mean <math>\pm</math> SD (n=4)</b>	<b>Differences Statistically Significant?</b>
Pre-test	85.79 $\pm$ 12.44	79.69 $\pm$ 12.63	93.75 $\pm$ 20.37	Yes
Post-test	90.58 $\pm$ 9.44	84.35 $\pm$ 10.05	96.00 $\pm$ 16.39	Yes

## **CHAPTER 6**

### **DISCUSSION**

#### **INTRODUCTION**

In this chapter, the most notable findings from the research study are discussed in more detail in terms of both implications and informing action. This chapter addresses the acute knowledge deficit that exists for primary school teachers caring for children with T1DM in Jeddah city in the KSA. It summarises the overall effectiveness of the experimental health intervention programme and comments on the longevity of the impact of the programme. Thereafter, the development of a standardised health education programme and what that would entail is discussed in greater depth, as well as the role of supporting materials and direct intervention with teachers. The chapter will address the effect of socio-demographic factors.

#### **THE KNOWLEDGE DEFICIT**

Generally, school personnel and school nurses across the globe have exhibited inadequate knowledge of T1DM, including the UK (Bradbury & Smith, 1993; Matyka, 2010), the US (Gormanous *et al.*, 2002; Nabor *et al.*, 2005); Turkey (Aycan *et al.*, 2012); and KSA (Gawwad, 2008).

#### **The Implications of Lack of Knowledge**

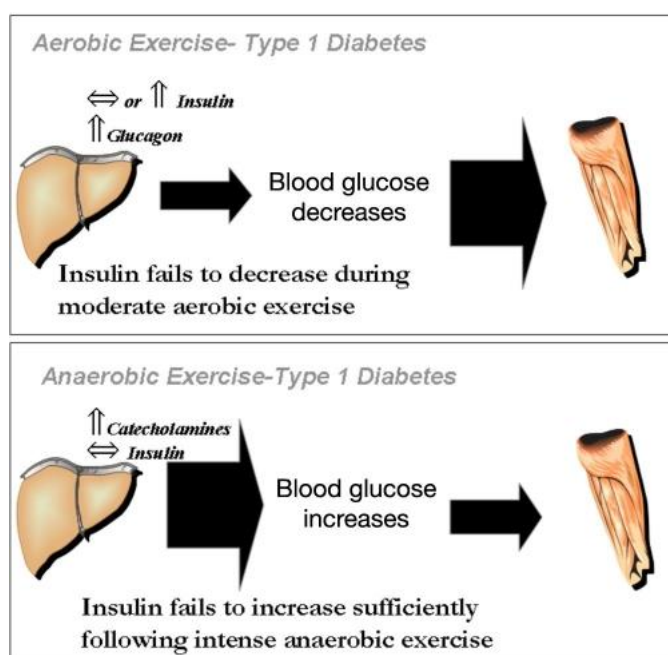
In the case of Saudi primary school teachers caring for children with T1DM in this study, the existing state of knowledge was found to be remarkably poor as a whole. This was the case for the entire cohort at the pre-test and remained so for the control group throughout. Section B of the instrument contained 41 questions regarding knowledge of T1DM in children, with a score range of 0-82. At the pre-test stage, the experimental group mean score was 15.18 (37.95%) and the mean score for the control group was 18.12 (45.3%). It is accepted that some of the statements in the questionnaire were designed to seek clinically precise knowledge of T1DM. For example, *statement 15* read "Hyperglycaemia is indicated by blood glucose more than 7.0mmol/L (126mg/dl)" and *statement 16* read "Hypoglycaemia is indicated by a blood glucose less than 4.0 mmol/L (70mg/dl)".

These types of statements were incorporated into the questionnaire in order to identify those individuals who had significant or advanced knowledge of diabetes. It

may be the case that answering these types of questions would have been too much to expect from the participants. It is not uncommon for school personnel to seek parental assistance in administering diabetes medication or to call for medical aid in diabetic emergencies (Frank & Daneman, 1998; Matyka, 2010). Nevertheless, these statements were included because in reality these types, or similar types of questions, reflect the details that are essential for the daily care of children with diabetes. For example, *statement 18* read "Frequent urination is a symptom of hyperglycaemia". When children with diabetes have high blood glucose levels in their body they develop hyperglycaemia, and a classic symptom of this condition is frequent urination (ADA, 2016). Individuals that are helping to take care of children with diabetes should therefore understand this and be able to look out for this symptom.

*Statement 44* read "Hyperglycaemia may be caused by too little insulin in children with diabetes". The most basic understanding of hyperglycaemia is that it results from too little insulin in the body, or when the body cannot use insulin properly. Insulin is used to break down blood glucose and when there is not enough insulin in the body, blood glucose levels rise (ADA, 2016). This type of basic knowledge is essential for those people caring for children with diabetes. *Statement 49* read "Regular physical exercises help in controlling hyperglycaemia in children with diabetes". When an individual has hyperglycaemia there is too much glucose in the blood system, and therefore blood glucose levels can be lowered through gentle exercise (ADA, 2016). This statement sought to identify such basic knowledge in the participants. It is considered to be basic because, when individuals who have particularly high blood glucose levels above 240 mg/dl and also have ketones in their body, exercise will make blood glucose levels go even higher (ADA, 2016). Riddell and Perkins (2009) observe that prolonged moderate-intensity aerobic exercise will cause a reduction in glucose concentrations, but anaerobic exercise can often increase blood glucose levels because of elevations in catecholamine hormone levels (Figure 23).

Figure 23: T1DM and Aerobic and Anaerobic Exercise (Riddell and Perkins, 2009, p.915)



For example, if a child at school takes a blood glucose measurement which is high, and in response a teacher tells the child to exercise, the child's blood glucose levels will rise even higher if the child has ketones in his or her body. There would then be a possibility of the child developing ketoacidosis or diabetic coma (ADA, 2016; Ly et al., 2014). If teachers at school who are caring for a child with diabetes have no correct understanding of *statement 49*, then there may be circumstances where they may inadvertently put the child at risk. Alternatively, there may be circumstances where they are unable to assist the child when the child is at risk. Consequently, these questions reflect the type of knowledge that is actually required by people who are providing care and assistance for children with diabetes.

### Availability of Trained Personnel

According to the ADA (2006), schools equipped to address the management needs of diabetes in school children have school nurses or other school personnel who are knowledgeable of the health and safety needs of children with diabetes, and who are trained to recognise and deal with medical needs of children with diabetes. Yet, many schools have no policies related to blood glucose monitoring, diabetes management, or staff administration of diabetes medication (Greenhalgh, 1997; Lewis *et al.*, 2003; Matyka, 2010; Nabors *et al.*, 2005). The findings from this study confirmed recent literature that noted the absence of trained school personnel and

policies related to diabetes management in schools for children with T1DM. Over 90% of the participants from the experimental group and control group reported that their schools did not have a facility to monitor students with T1DM and did not employ school health specialists to deal with issues related to children with T1DM. These results were consistent with existing literature regarding the absence of safety provisions and policies within the Saudi school system (Gawwad, 2008).

It may be that the high costs associated with development and implementation of management plans in schools for children with diabetes is a major reason why the majority of schools in the KSA have been slow to train teachers and to provide on-site diabetic treatment facilities. The limited knowledge demonstrated by the primary school teachers in this study may be attributed to the absence of available resources and training programmes. This highlights the potential benefits of implementing training programmes for teachers and staff on managing T1DM in school children. Currently, there are almost non-existent throughout the Middle East (Gawwad, 2008).

The questionnaire also contained numerous other statements which sought to identify more basic knowledge regarding T1DM: for example *statement 35* ("Heart disease is a complication of T1DM"); *statement 36* ("Kidney failure is a complication of T1DM"); *statement 37* ("Blindness is a complication of T1DM"); and *statement 38* ("High blood lipids is a complication of T1DM"). Added to this there were many statements that were clearly relevant to the management of T1DM in the school setting. These included statements relating to symptoms exhibited by T1DM such as *statement 29* "Excessive sweating is a symptom of hypoglycaemia in children with diabetes", and *statement 30* "Excessive hunger is a symptom of hypoglycaemia in children with diabetes". The questionnaire also included statements relating to the management of T1DM in children such as *statement 42* "Unsweetened fruit juice has an effect on the blood glucose of children with diabetes" and *statement 43* "Three hard candies are enough to treat hypoglycaemia in children with diabetes".

### **Lack of Experiential Knowledge**

The type of basic information regarding T1DM in children exemplified by these statements, combined with the lower mean scores at the pre-test stage clearly show that both groups of participants possessed minimal knowledge about T1DM management in school children. Generally, the participants were not aware of the



medical aspects of managing school children with T1DM, or familiar with their diabetes-specific psychosocial needs. While it might be argued that this was not a stated part of their role as teachers, the incidence of T1DM in Saudi children means that such children will be present in increasing numbers in classrooms. The implication is that, in the absence of trained nurses, teachers will be the only source of safe, effective management of diabetes for children during school hours.

Once more, these results support previous claims that teachers lack adequate knowledge about diabetes (Greenhalgh, 1997), that they are poorly informed about T1DM, and inadequately prepared to deal with common issues such as insulin management and hypoglycaemia (Gormanous *et al.*, 2002). These findings support earlier claims by Gawwad (2008) who found teachers in the KSA had inadequate knowledge of children with T1DM. Still, the study participants were probably inexperienced or had minimal encounters with students in their classroom with T1DM. Nearly 79% of experimental group participants and approximately 52% of control group participants reported not having students with T1DM in their classes. This was the same across all grades from 1 to 6.

### **Attitudes**

Participants in both groups demonstrated positive attitudes towards children with T1DM. The results from the study clearly contradict the findings from past studies which found that teachers in KSA reported having negative or unfavourable attitudes toward managing diabetes in school children (Gawwad, 2008). Many of the participants were not fearful or anxious about their potential role in assisting students with diabetes in school, as suggested in previous studies by Boden *et al.* (2012) and Bradbury and Smith (1987). It may be that these negative or unfavourable attitudes have waned over time, especially for educators in Saudi Arabia where the epidemic of childhood diabetes continues to grow. Furthermore, there was anecdotal evidence that some teachers in the control group were keen to learn about T1DM in children (as some asked if they could have had the education programme). They were informed about the purpose of the control group and promised the package at the end of the study. The new evidence provided by this research study should prompt intervention by the Saudi Ministry of Education in order to improve health outcomes for children with T1DM, and to allow teachers to enjoy greater satisfaction from fulfilling their role more effectively.

## THE EFFECTIVENESS OF THE EXPERIMENTAL INTERVENTION

From the literature review, it was apparent that using an experimental intervention had been found to be effective in increasing knowledge levels of participants. However, that level of increase was not notable in most cases. This may have related to the limited selection of modes of interventions that were used in the studies. For instance, Gesteland found no significant improvement in knowledge after comparing the groups of participants. This led to the conclusion that mass education to elementary teachers was ineffective (Gesteland, 1989). Jarett *et al.* assessed the effectiveness of a programme in which motivated, knowledgeable parents would teach elementary school teachers about taking care of children with T1DM. A significant improvement in knowledge was observed yet a number of basic concepts remained unclear (Jarett *et al.*, 1993).

Some interventions were more efficient than others, such as using a computer-based training system (Radjenovic and Wallace, 2001), or providing training by certified diabetes educators (Gutierrez, 2011; Siminerio and Koerbel, 2000), but no individual approach was seen to be effective alone.

Accordingly, the intervention used in this study included a combination of lectures, educational videos, booklets, question and answer sessions and interactive learning. The increase in the participants' post-test knowledge scores following the health education programme supported previous research, which suggested that intervention programmes could improve knowledge levels of teachers regarding the management of diabetes in school children (Aycan *et al.*, 2012). However, the multi-mode approach was an important factor.

The study findings offer important insights into the vital success factors for embarking upon such an enterprise. In fact, despite limited resources and the need for concurrent and repeated experimental testing, the health programme intervention in this study was demonstrated clearly to be highly effective in practice. The knowledge levels of 209 participants in the experimental group significantly increased over a period of 6 months, with a 116.93% improvement in knowledge levels overall, despite using minimal resources. These findings were consistent with research conducted by Siminerio *et al.* (2000) who reported poor knowledge levels for school nurses and teachers pre-intervention, but sufficient gains in knowledge of issues surrounding glucagon and hyperglycaemic episode post-intervention. If this type of improvement

in knowledge can be achieved using marginal resources, then perhaps even more could be achieved with additional resources. Gutierrez (2011) implemented an online training programme for schools with nurses and without them, and individuals volunteered to complete the easily accessible and convenient program.

In practice, the Saudi Ministry will require guidance on what needs to be done and how the task should be undertaken. For example, better quality of materials provided by the health education team in the Ministry of Health might improve the quality of the programme. Alternatively, digital production with supporting helpful information, or applications for personal use, to quickly refresh the memory might improve the quality of the programme. So, too, might a dedicated national website that is made available for teachers to access at any time to improve their knowledge or to seek answers to questions.

The attitude levels of the participants in the experimental group also showed significant increases. The mean pre-test score of 80.52 increased to a post-test mean score of 85.14, a 5.74% increase in attitude levels three months after the health intervention programme. This finding confirms existing research by the International Diabetes Federation in suggesting that education programmes or other intervention can encourage positive behaviours including self-awareness, self-confidence, and empathy (IDF, 2015). It is somewhat disappointing that there was only a small positive increase in attitude scores following the programme. However, the majority of experimental group participants (79.2%) and control group participants (52.2%) reported not having students with T1DM in their classes. In these cases, the participants had almost no opportunities to continue implementing the knowledge obtained from the intervention.

Future research can explore the knowledge of teachers after another 3 to 6 months (after the start of a new school term) to determine the retention of knowledge in order to enhance and strengthen existing programmes. Knowledge retention is important in practice for teachers to aid in improving the quality of care and support for children with T1DM. At the same time, there must be a corresponding change in attitudes as well. Indeed, by participating in the health intervention programme, participants not only increased their knowledge of T1DM management for children with diabetes, but they also felt more positively in their views towards them. Further studies could

explore the influential factors that contribute to teachers developing more favourable attitudes towards children with T1DM. Such studies might adopt qualitative approaches to discover the emotional and behavioural impact that programmes can have on teachers.

## **THE LONGEVITY OF THE IMPACT AND THE IMPORTANCE OF SUPPORTING MATERIALS**

### **Supporting the Effect of the Intervention**

Importantly, the intervention was effective beyond the immediate period. Significant differences were found in the knowledge and attitude scores for the participants in the experimental group over time. From the pre-test to post-test to post-test 2 stages, the knowledge levels of the experimental group continued to improve after participants were exposed to the health education programme intervention. It can be inferred that the teachers experienced the greatest rise in knowledge retention three months after the intervention but still managed to improve their knowledge levels even six months following the intervention.

This additional small rise in knowledge levels at the six months stage is suggestive of the longevity of the impact of the intervention. The indication is that the results of the health intervention programme are permanent or at least semi-permanent, rather than temporary or fleeting. It might be expected that retention of knowledge would diminish over time, but this was not the case. This might also tend to suggest that regular knowledge refreshment updates held at strategic points throughout the school year should form a central element of maintaining the knowledge and skills of teachers and establishing such competence for new teachers.

### **Teacher Professional Development**

El-Deghaidy *et al.* (2014) acknowledge that teacher professional development is now widely recognised as a national priority in the KSA. They also believe that effective continuing professional development (CPD) is essential for teachers because it may promote the quality of teaching and learning in schools. At the same time they argue that some teachers in the KSA have been presented with CPD content that does not reflect their professional needs, or match their preferred type of learning (El-Deghaidy *et al.*, 2014). Another study of 605 teachers in the KSA (located in Mecca,

Taif, and Majmah) by Mansour *et al.* (2014, p.101), found that "Most teachers' descriptions of how they spent their CPD were deemed to be passive and subservient rather than active participation in knowledge-creation or offering leadership to others." A study undertaken by Alharbi (2011) into the development and implementation of a CPD programme for newly qualified teachers in the KSA, found that this approach might prove to be highly beneficial in practice, but would require the full engagement of all stakeholders in order to have a positive effect.

Sywelem and Witte (2013) undertook a study on the practical applications and perceptions of CPD by 295 elementary school teachers sampled from 20 elementary schools in the province of Jazan in the KSA. They found that there was a distinct need to connect professional development efforts with relevant classroom topics and strategies as this would allow teachers to gain and recognise the need for new knowledge and skills. Sywelem and Witte (2013, p.881) believed that by aligning school objectives with the needs of teachers and administrators, Saudi schools can "promote teacher involvement, professional growth, and can lead the way to establishing mentoring relationships that can ensure continuous improvement occurs." Consequently, it is proposed that by integrating the health education programme within a CPD teaching framework, both schools and teachers would benefit. Teachers would participate in structured CPD learning that would contribute to their professional development, and which would also involve active rather than passive participation. Schools would benefit by providing better support for students. Such a scheme would involve the full engagement of all stakeholders and might potentially result in improved outcomes for teachers, students, and schools.

### **Development of a Standardised Health Intervention Programme**

The success of the health education programme intervention warrants further commentary on both the nature of the programme and its potential subsequent use. If this type of programme is to be used widely within Saudi schools and other Saudi institutions then standardisation of its content and delivery would be required in order to ensure consistency and quality throughout its use. In practice this might require the development of a standardised health education programme package that contains all the required materials and instructions in both English and Arabic. In addition to this, one crucial aspect of the adoption of such a programme in Saudi schools is the backing and support of educational leaders at both school and

government levels. This might require concerted efforts on the parts of the Saudi Ministry of Education and Ministry of Health. It might also require better co-ordinated efforts to be made between schools, local health centres and school health care units in the KSA that might be able to help to deliver the health education programme more effectively in schools throughout the KSA.

### **Development of a Health Intervention Programme for other Health Issues**

In theory, the success of the health intervention programme on the participants means that it is worthwhile investigating whether or not this type of programme could be used and adapted for other health issues. For example, mental health and wellbeing, obesity, and asthma are also significant health issues for the Saudi population, may be given to improvement through better care during the school day, and might be susceptible to a similar approach of multi-faceted education programmes for school teachers. The teachers in this study needed only to be shown their lack of knowledge and training to become eager, active learners in order to provide better health support to children. This motivation may well transfer to the equally prevalent problem of asthma in school children.

### **The Role of Supporting Materials**

The provision of self-study materials should be part of the overall health education programme strategy. It is proposed that the efforts made in the intervention events were significantly reinforced by the provision of additional reading materials. Supporting materials such as information packs have been used in other school diabetes education programmes (Appendix [12]). The evidence would seem to suggest that it is a mixture of different educational elements and subsequent supporting materials that facilitated participants significantly increasing their knowledge of children with T1DM. There were anecdotal comments from some of the participants that they had found the videos and interactive learning helpful. Other research studies have also demonstrated the strength of blended learning (Sadeghi, Sedaghat, and Ahmadi, 2014). Hande (2014) conducted a cross-sectional study of 96 students in a premedical cell biology class using blended learning, i.e. the integration of classroom face-to-face learning experiences with online learning experiences. It was found that the students found that blended learning engaged the students more and facilitated a more interactive classroom environment.

Shantakumari and Sajith (2015) conducted a cross-sectional study at the Gulf Medical University in Ajman, United Arab Emirates. The study collected the viewpoints of 75 students enrolled in classes there, and reflected their perceptions of the blended learning process, content, and ease of use (Shantakumari and Sajith, 2015). It was found that there was evidence that suggested that the students there held positive perceptions of the blended learning environment. Halpern and Hakel (2003) demonstrated that knowledge is enhanced when information is represented in both visual and auditory formats. Franklin and Peat (2000) demonstrated that the use of mixed delivery modes to educate students at the University of Sydney increased learning opportunities for students there. Williams (2013, p.1) demonstrated that the literature supported the notion that cognitive processing could be enhanced by "augmenting online videos and exercises with questions and prompts for students to generate explanations: *before, during, and after learning*", i.e. interactive learning.

The intervention programme included educational videos, interactive learning, question and answer discussions, participant sharing and interaction (common experiences, concerns, and hopes for learning), and supporting materials in the form of participant welcome packs and diabetes booklets. There is therefore anecdotal and literature-based evidence to support the contention that this combination of different types of learning methods and materials facilitated and enhanced the overall learning process for the participants. For example, participants were not simply expected to sit in a classroom for 180 minutes and listen to a lecture on diabetes and children with T1DM, and perhaps become bored or lose concentration.

It might also be argued that the five stages of the health education programme reinforced learning for the participants. Part 1 (Introduction) allowed the participants to be given a clear view of what to expect from the five different parts of the programme. Part 2 (Setting the scene) gently eased the participants into discussing issues relating to diabetes and children with T1DM. Part 3 (Overview of the key issues in diabetes) then provided the participants with more details and knowledge about the signs, symptoms, and treatment of T1DM in a simple way to understand video format. Part 4 (Interactive learning) reinforced the take up of knowledge by allowing the participants to put into action what they had learned and to fill in any gaps in their learning that may have been identified during group work scenarios. Finally, Part 5 (Plenary) may have provided the participants with a unique opportunity

to address gaps in their knowledge. The group work may have allowed the participants to feel more comfortable with asking questions relating to gaps in their knowledge in front of the group (Mensing and Norris, 2003).

### **The Role of Online Resources**

More work is certainly needed to establish more robust and easily updatable resources, including online learning materials. This type of easily accessible resource might find use not only across the KSA, but likely in other Middle Eastern countries that have also shown a high prevalence of T1DM in children. Anecdotal comments made by teachers at the end of the study corroborated the usefulness of such support, whilst the explicit eagerness of teachers in the control group to access the pack after the final data collection episode, was further evidence of the value placed on the learning materials. The effectiveness of online learning from support materials is also demonstrated in the literature. A systemic search of the literature (1996 to July 2008) identified more than a thousand empirical studies of online learning (US Department of Education, 2010). Key findings from a review of these studies included that the effectiveness of online learning approaches appeared to be broad across different types of content and learner types, and that this type of online learning support could be enhanced by giving learners control of their interactions with media. It was also found that variations in the way in which online learning was implemented did not affect learning outcomes significantly, nor did video or online quizzes influence the amount learned (US Department of Education, 2010).

This suggests that some type of T1DM online information and learning portal might be of significant use in supporting the intervention programme. The Kuwait Health Network Learning Zone is an example of what such a type of information and learning portal might look like in practice (<https://learning.health.org.kw/>). It is an open knowledge zone that contains the latest guidance, protocols, and open access education resources for all healthcare professionals. Other studies have explored the importance and effectiveness of online support materials for individuals with diabetes (Ma *et al.*, 2006; Handley *et al.*, 2010; Tang *et al.*, 2010). Indeed Mason (2012) has even argued that a focus on the process of development of educational materials and resources could potentially be widened to include not only health, behavioural, and utilisation measures, but also the promotion of patient empowerment, and increased levels of patient agency.



In this way, T1DM educational materials might be developed not only to provide teachers with diabetes knowledge, but might be developed to empower teachers to take a more active approach in the management of T1DM in Saudi schools. The supplementary use of a learning portal would not damage the usefulness of personal attendance at the health education programme sessions. Nor is it the case that a learning portal alone would be effective in providing the health education programme intervention. This would eliminate the face-to-face engagement provided by the health education programme, as well as the interactive group sessions which stimulate the personal involvement of attendees. Additional online learning materials might improve the subsequent interaction of the attendee with the programme through greater knowledge immersion.

Another study by Jones *et al.* (2011) analysed over 179 individual data units provided by eight nurse participants to investigate barriers and benefits associated with nurses information-seeking related to patient education needs on clinical nursing units. It was found that the nurses "perceived the diversity and variety of web-based information and formats to be distinct advantages, but face considerable barriers to web-based searching on the unit, including a lack of time, lack of experience, organization barriers and others" (Jones *et al.*, 2011, p.29). This would also support the development of a single point of online information and support materials for teachers in order directly to address time, experience, and organisational barriers.

### **The Knowledge Levels of the Control Group**

The knowledge levels of the control group participants decreased at post-test, but then increased slightly by post-test 2. This increase was shown to be statistically significant. There are several potential explanations for this fluctuation in knowledge levels. It might be the case that simply completing the questionnaire prompted some of the participants to recognise their lack of knowledge and to seek to acquire more knowledge. Another explanation might be that some primary school teachers learned more about the condition from the parents, if they had a child with T1DM in their class. Another explanation may be that some of them learned about the T1DM from other resources, such as the internet, magazines, radio, or television during the course of the study to gain the knowledge about T1DM in children.

Another preferred explanation is that the fluctuation over time in the knowledge levels of the control group participants derived from them having low levels of knowledge on diabetes and so some of the control group participants were guessing answers each time they took the test. This type of random guessing could account for the fluctuations in knowledge levels at the different testing stages. The fact that there was no significant change in attitude levels of the control group participants supports the view that there were no external stimuli acting on the group. If knowledge levels had been changed by external stimuli it is logical to believe that we would have seen some change in attitude levels of the control group participants. But this was not the case. The results for the control group were consistent with past research studies that found that teachers gained the most information about T1DM from the children's parents (Bradbury and Smith, 1983), or teachers' knowledge improved with the aid of media and other sources, including magazines, newspapers, and medical literature (Bradbury and Smith, 1983; Diabetes UK, 2008).

## **DIRECT INTERVENTION WITH TEACHERS**

### **The Potential for Teachers to Exert an Impact**

While there is no professional health support, it may be that this individual, first-hand intervention directly with teachers themselves will be sufficiently effective (and cost-effective) without undertaking major structural changes at schools in the KSA. Sending teachers and other key school staff on external health training courses may not be an option for many schools in the KSA, because of the number of teachers and staff, a lack of availability of such training courses, or because of limited annual school budgets. Yet the significant positive effects of the health education programme intervention can be replicated and achieved in a cost-effective manner in Saudi schools. The health intervention programme that has been devised takes less than 3 hours to deliver and has the potential to exert a positive impact on the management of T1DM children in Saudi schools.

The results showed an overwhelmingly positive response was experienced from teachers that participated in the research study. It was seen that they were enthusiastic and thirsty for knowledge and wished to upgrade their skills. It was also clear that they were motivated to put more effort in than simply attending the event. In practice this type of motivation should invariably be harnessed, recognised, and

fostered since these teachers play a crucial role in children's development and health within the school setting. The findings showed that teachers in the experimental group maintained their interest in learning about diabetes by reading the provided booklet, or by independently researching other resources to keep them updated about the condition.

Over 80% of the primary school teachers reported that they were not currently teaching students with T1DM, yet even these teachers felt positively about such children. Education is not just about teaching children, it is about providing a high quality educational experience for the child. This type of experience requires highly qualified, trained, motivated and dedicated teachers who are committed to providing not only the best education possible, but also the best possible enjoyment of education and love of learning in children. In the KSA this requires at a minimum explicit acknowledgement at a national, Ministerial level of the importance of the teacher's role in this field. This would certainly provide a boost to teacher morale and would be motivating for even greater achievement of the incorporation of health in the curriculum in schools.

### **Demographic Variances**

Although the intervention worked for grades, age, location and sex of staff, the findings indicated subtle differences in the needs and reactions of sub-groups of teachers. A statistically significant difference was found between the 35 to 44 year-old group of participants, and the 55 or older group of participants. Although, the 55 or older age group (29.6%) reported having more students with T1DM in their class than the 35 to 44 year-old group (27%), they had the lowest pre-attitude scores. In relation to Saudi teachers, Elyas and Picard (2012, p.1083) state that "They have been educated in a conservative moral tradition based on a clearly-defined role as Islamic educators and purveyors of Saudi nationalism".

It may be the case, therefore, that this conservative approach applied within the field of education may result in older teachers exhibiting clear-cut views and opinions about their single role as an educator within the classroom setting. They may view health and medical matters as being beyond the confines of their educational role, or as being beyond their particular teaching expertise. In contrast, participants in the 35 to 44 year-old age group may have had more modern and progressive views of their

role as a teacher within the classroom setting. They may have been a little less reluctant to possible changes in their underlying roles as teachers and educators, especially as it relates to managing children with T1DM, and more open to the additional responsibilities associated with the needs of children with T1DM.

## **CHAPTER 7**

### **CONCLUSIONS**

#### **NEEDS OF CHILDREN WITH DIABETES IN SCHOOLS**

The needs of children with T1DM during school hours are wide ranging (Matyka, 2010). Children with T1DM may develop hypoglycaemia (Chiarelli *et al.*, 1999; Siminerio and Betschart, 1999; Liese *et al.*, 2006); hyperglycaemia (Siminerio and Betschart, 1999); and Neurocognitive Dysfunction (Desrocher and Rovet, 2004; Ryan, 2006; Gaudieri, 2008; Naguib, 2009). There are psychological and behavioural challenges, and increased risk of the onset of anxiety, depression, and eating disorders (Alnasir, 2003; Kakleas *et al.*, 2009).

#### **STUDY AIMS AND OBJECTIVES**

The aim of this study was to measure the effectiveness of a specifically designed intervention (T1DM health education programme) on the knowledge and attitudes of primary school teachers based in primary schools in Jeddah, KSA, over a six month period. This study focused on the impact on teachers, rather than children. The research objectives were to incorporate the measurements of knowledge and attitudes of primary school teachers taken at pre-test (*baseline*), post-test (*3 months*), and post-test 2 (*6 months*) intervals.

The study established pre-test, post-test, and post-test 2 measures (knowledge and attitudes). The study administered the health education programme. The study compared pre-test, post-test, and post-test 2 measures (knowledge and attitudes) in the control groups and experimental groups. The study observed and assessed changes in these measures over a period of 3 months and again at 6 months. The study examined the impact of sociodemographic factors (gender, age group, level of education) on the pre-test and post-test scores (knowledge and attitudes) of primary school teachers in the experimental group. The aim and objectives were explicitly met by this research study.

#### **RESEARCH QUESTIONS**

The research study adopted 14 research questions:

Questions 1 and 2 sought to identify whether there was a difference in the knowledge and attitudes about children with T1DM between the control group and experimental group at the pre-test stage.

Questions 3, 4, 5, and 6 sought to identify whether there was a difference between the control group and the experimental group in knowledge and attitudes before and following the health intervention.

Questions 7, 8, 9, and 10 sought to identify whether primary school teachers' knowledge and attitude changed over time (from pre-test to post-test 2 stages) in the control group and the experimental group.

Questions 11, 12, 13 and 14 sought to identify what impact (if any), socio-demographic factors (gender, age group, level of education) had on primary school teachers' knowledge and attitude pre-test and post-test scores.

## **STUDY DESIGN**

A repeated measures, non-equivalent groups study design was used with testing at baseline, three months, and six months, and data collection from 2013 to 2014.

### **Recruitment**

A total of 540 teachers were recruited in equal numbers by gender from 90 primary schools located in Jeddah City. Eighteen primary schools were used from each of the North, East, South, West, and Centre sections of Jeddah City. Participants in the experimental group were chosen from 60 schools (n=360) and participants in the control group were chosen from 30 schools (n=180). Participants with first degree relatives with T1DM, participants with a background in health care, and participants with recent training in management of T1DM were excluded from the study in order to minimise bias. Although this exclusion was important, it is worth noting that it would be interesting to see if this exclusion would have made any difference to the study in future research. **The method of recruitment and selection worked effectively, securing a large sample in an ethical and efficient manner.** The method could be adopted in other studies and could be used in other Middle Eastern countries.

## Devising the intervention

The final health programme intervention was built up slowly over a period of time. It began with a review of the international literature on best practice, as well as identification and analysis of the content of other health programme interventions. Standard educational programmes typically consisted of lectures and activities with additional reading materials. The literature supported the effectiveness of blended learning, and consequently a multichannel delivery programme was devised to provide a holistic approach to learning. The five phases of the programme were put in place to build up the knowledge of the participants (overview, presentation, video), and to reinforce knowledge learned (role playing exercises).

The timing of the overall programme was balanced and limited (180 minutes) in order to ensure that participants remained receptive. It was seen that the construction of a population-specific instrument was essential and effective. The questionnaire instrument was built up by drawing from other research instruments that had covered similar issues, and then further statements were devised to balance the mix of easy, intermediate, and advanced diabetes knowledge. **The intervention was novel and the first to be used in the Gulf Region. The approach to development and implementation was effective and could be replicated elsewhere, such as other Middle Eastern countries.**

## The Questionnaire

A structured, self-administered questionnaire in Arabic was used as part of the health intervention. The questionnaire incorporated elements from other questionnaires such as the types of questions and statements used. However, these were then developed and refined separately in order to address the aims and objectives of the study more accurately. The participant information sheet and consent form were incorporated as part of the questionnaire in order to guide the participants in terms of what was required from their participation in the study. The questionnaire was then split into three parts in order to solicit information about the participant (Section A), the participant's knowledge of T1DM in children (Section B), and the participant's attitudes towards children with T1DM.

The knowledge section B used diabetes statements to cover six key areas of diabetes: (1) T1DM definition and symptoms; (2) hyperglycaemia and ketoacidosis

symptoms; (3) hypoglycaemia symptoms; (4) complication of T1DM; (5) hypoglycaemia and hyperglycaemia causes and treatment; and (6) diet and controlling T1DM. The attitude Section C devised a range of statements to cover five key areas of children with T1DM: (1) managing T1DM in school; (2) the rights of children with T1DM; (3) rules in physical education classes, trips, care plan; (4) teachers reaction at emergencies; and (5) training in T1DM. **The final questionnaire was new, available in Arabic and English, and it could be used again in other countries. It could also be used in other studies to enable direct comparison between results.**

## **FINDINGS**

### **General knowledge deficit**

There was a clear deficit of general knowledge of diabetes and caring for children with T1DM demonstrated by 318 primary school teachers working in Jeddah. Both the experimental group (mean=15.18) and the control group (mean=18.12) showed low levels of knowledge at the pre-test stage. **Although some previous evidence suggested fair knowledge shown by school teachers in the KSA, this was the first time that the dimensions and specific nature of the problem in this key health issue for the KSA was identified and quantified. This finding contributes to the scarce literature on this significant area.**

### **Effectiveness of the educational programme**

The study findings clearly demonstrate the effectiveness of the health educational programme on the study participants. At the post-test stage (3 months) the experimental group participants showed a 96.64% increase in mean knowledge levels. At the post-test 2 stage (6 months) they showed a 116.93% increase in mean knowledge levels. The difference in these mean scores was shown to be statistically significant. The teachers experienced the greatest knowledge retention three months after the intervention (+14.67), but still managed to improve their knowledge levels even six months following the intervention (+3.08).

This large and significant increase in mean knowledge levels of the school teachers provides evidence to substantiate the effectiveness of the content and structuring of the health education programme. **The intervention proved to be an appropriate means to improve knowledge which was still at an increased level after 3**



months. This new programme, while it could bear further improvement in presentation, is otherwise ready to be employed in other parts of the KSA and beyond. The model could be extended for use with other health issues.

### **The Impact on Attitude**

Overall, the health intervention had a positive impact on the attitudes demonstrated by the school teachers towards children with T1DM. At the post-test stage there was an increase in the mean attitude scores of 4.62, and at the post-test 2 stage there was an increase in the mean attitude scores of 3.74. Although there was a decline in attitudes shown at the post-test 2 stage, this decline was small (0.88). **The significant increase in mean attitude scores overall is important, because it demonstrates that in addition to improving knowledge levels, the health intervention positively affected the personal views of the participants regarding children with T1DM. The model has the potential to improve teachers' attitudes towards children with T1DM in other schools across the KSA.**

### **Demographic Issues**

Sociodemographic factors (age, gender, level of education) had no impact on the knowledge levels of the participants at the pre-test stage. At the post-test stage females showed significantly higher mean knowledge scores (female=32.72, male=27.6), but there were no statistically significant differences for age or level of education factors shown. The difference in female and male scores demonstrates that either the programme was more effective on females, or females were more receptive to the programme than males. At the post-test stage males showed significantly higher mean attitude scores (male=87.38, female=82.29), and teachers with postgraduate qualifications showed significantly higher mean attitude scores (postgraduate=96, bachelor=84.35, diploma=90.58).

There were mixed results for the attitude scores of different age groups. At the pre-test stage there was a significant difference found between the age groups, and at the post-test stage there was no significant difference found. **These findings provide new knowledge on the different effect of health intervention programmes on males and females. The programme improved the knowledge of females more and improved the attitudes of males more. The findings also demonstrate that there is a link between levels of education and positive**

**attitudes towards children with T1DM after the health programme was implemented.**

### **The potential impact on and by teachers**

The health intervention had a positive impact on both the knowledge and attitudes of primary school teachers towards children with T1DM. The study showed that the health programme was a cost effective success, and that it has the potential to positively impact teachers in primary schools across the KSA in the same way. If the health programme improved the knowledge and attitudes of teachers towards T1DM, then it is logical to conclude that this can potentially improve the care of children with T1DM within the school setting.

Teachers have more knowledge of T1DM and caring for children with T1DM, and they have more positive attitudes towards children with T1DM. By participating in the health programme teachers were empowered with a better ability to help children with T1DM within the school setting. **Diabetes has now risen to epidemic levels in the KSA, and the number of children with T1DM in the KSA is significantly rising every year. The study showed that many teachers in primary schools in Jeddah had very poor levels of knowledge of diabetes. This study demonstrated a new and cost-effective way that children with T1DM in primary schools in the KSA could potentially be helped by teachers in their management of T1DM.**

### **RECOMMENDATIONS**

Taking on board the conclusions that can be drawn for this study, a number of recommendations for practice in schools, for policy in the KSA, and for further research can be made.

#### **Recommendations for practice in schools**

- Schools should ensure adequate safety, care and psychosocial support for children with T1DM. This should include the development of a school diabetes plan, comprehensive diabetes training and education for school personnel, and adequate facilities for blood glucose monitoring and insulin injections.

- Schools should aim to improve communication between school staff, teachers and children with T1DM to help to support the children's needs (Nabors *et al.*, 2005).
- Schools should make active efforts to improve the management of T1DM in children at school by teachers and parents (Freeborn *et al.*, 2013).

### **Recommendations for policy in the KSA**

In light of the success of the cost-effective T1DM health education programme intervention, the Saudi Ministry of Education would be well advised to consider implementing this type of programme across Saudi schools. There are also other policy recommendations that can be identified.

- **Commissioning Further Research.** The Saudi government might consider commissioning further research which could help to identify how and why the programme works in practice, if the programme works in other Saudi schools in other major cities and/or schools in rural and provincial areas in the KSA. Further research could provide a better analysis of projected implementation and annual running costs, and how improve the quality and effectiveness of the programme.
- **Standardisation of the Programme.** In order to be able to implement a programme that is effective throughout all public and private schools in the KSA, the programme could be professionally standardised. This would include standardisation of the programme materials; instructions; minimum qualifications and experience required; information booklets; videos; handouts; role play scenarios.
- **Local and Regional Pilot Testing of the Programme.** The programme could be pilot tested at local (e.g. Riyadh, Qasim, Madinah) or regional (North, South, East, West, Central) levels, prior to national implementation. The pilot testing might be able to provide a clear indication of the overall success of the programme, and would allow the programme to be implemented at a national level faster in order to help children with T1DM sooner rather than later.

- **Integration of the Programme into the School Curriculum.** The programme could be integrated into the school curriculum. The Saudi Ministry could enlist the help of local clinics or school health unit to work with schools to help guide and integrate the programme into the school curriculum. The programme could be introduced as part of a school teacher Continuing Professional Development system. The programme could be introduced by school nurses via a "Train the Trainer" type of system. School nurses or teachers from schools could attend a special training course or training day where they would learn about the programme and T1DM, and they would learn how to implement the programme and updates.
- **Saudi National Awareness Campaign.** The Saudi Ministry could commission a national T1DM programme awareness marketing campaign. People in the KSA would gain increased knowledge and awareness of the issues surrounding children living with T1DM. If the programme is promoted at a national level by the Saudi government, then this would likely have a "top-down" effect on the people in the KSA, so that there would be a greater willingness on the part of teachers, school officials, and parents to take part in the programme.
- **Citywide and National Roll Outs of the Programme.** The T1DM health intervention programme could be first rolled out across all schools in major cities in the KSA. The Saudi Ministry of Education could coordinate this and oversee administration, budgeting, and oversight of the programme. The Saudi Ministry could put in place a reporting framework for schools in order that the programme is monitored and evaluated on its success.

#### **Recommendations for further research**

- **Provincial KSA Research Study.** Further research of the same type undertaken in this study could be carried out in male and female schools in public and private schools in smaller provinces, towns, and rural areas in the KSA. This might show if this type of health education programme intervention could be used in all schools throughout the KSA, or whether it would need to be changed, amended, or updated in some way to better reflect different

social, cultural and administrative operational environments in these types of schools.

- **Longitudinal Research Study.** Further research of the same type over a longer period (e.g., 12 months to 24 months). This type of future research might provide insight into whether a longer health education programme intervention could provide better or permanent results. This research might incorporate a "booster" health education programme intervention, e.g. every 6 months.
- **Mixed Methods Research Study.** Further research of a similar type to the current study could be carried out but using mixed methods instead. In addition to the quantitative methodology the research could adopt a qualitative methodology as well such as semi-structured interviews or qualitative survey forms as the research instrument. This type of research might provide deeper and richer insights into the subjective beliefs and opinions held by the research participants. It could help to explain why the health education programme intervention worked, and what aspects of the programme were important in its overall success. This type of research might be able to improve the health intervention programme by seeking out what parts participants found beneficial.
- **Grounded Theory Research Study.** In addition to a health intervention programme a qualitative research study might use a grounded theory analysis in order to draw out key themes from the responses of the participants. These could then be used to identify what parts of the research study were effective, and why. El Hussein *et al.* (2014) argue that grounded theory has a number of advantages as a research method. These include: (1) it has an intuitive appeal which allows researchers to become deeply immersed in the data; (2) it fosters creativity; (3) it has significant potential in terms of conceptualisation, in that it separates the relevant from the irrelevant; (4) it provides a systematic approach to data analysis; and (5) it provides for rich and deep data to be obtained (El Hussein *et al.*, 2014).

- **Middle East Research Study.** Further research of a similar type to the current study could be carried out within the context of another country in the Middle East such as Bahrain, Kuwait, Qatar, and the UAE. This type of research might show if the health education programme was culturally compatible with countries similar to the KSA, which have also demonstrated high prevalence rates for diabetes.
- **Impact on Children Study.** Further research of a similar type to the current study could be carried out in schools which had children with diabetes. The study would aim to examine how the intervention impacted the quality of care that children with diabetes received in those schools, and could also identify their care needs.

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## APPENDICES

**APPENDIX 1**  
**Sampling Diagram**

# STRATIFIED RANDOM SAMPLING



**Experimental Group = 60 Schools = 360 Teachers**

**Control Group = 30 Schools = 180 Teachers**

**Total = 540 Teachers**

**NORTH**

**18 Primary Schools = 20% of Sample**

**WEST**

**18 Primary Schools  
= 20% of Sample**

**CENTRE**

**18 Primary Schools  
= 20% of Sample**

**EAST**

**18 Primary Schools  
= 20% of Sample**

**SOUTH**

**18 Primary Schools = 20% of Sample**

**JEDDAH CITY**

**683 primary schools**

**20,100 primary school teachers (CDSI, 2013)**

**90 primary schools selected for sample  
(13.177%)**

## **APPENDIX 2**

**'Diabetes and School' provided by King Faisal Specialist Hospital and  
Research Centre, issued in 2010**



'Diabetes and School' booklet provided by King Faisal Specialist Hospital and Research Centre, issued in 2010





## داء السكري والمدرسة

### مقدمة:

يشعر معظم الأباء والأمهات بالخوف والقلق عند ذهاب طفلهم المصاب بالسكري إلى المدرسة، لذا فدروا جهة من مستويات إيقاع مستوى السكر بالدم ضمن المعدل المطلوب.

إن الحضور الجيد غير الضلوع للسكر ما بين أجرة الطفل وذلك بإشراك الطفل نفسه، والمدرسة، وفريق الرعاية الصحية للكف بالإنابة بالطفل من طبيب، وأخصائية التغذية الصحية، وأخصائية النفسية لتجعل الطفل يتصرف يومياً طبيعياً فحسب، بل إنها ستعطي شعوراً بالثقة عند كل من الطفل وعائلته عند ذهابه اليومي إلى المدرسة.



### المحتويات:

١. أهمية.....
٢. التعاون للمدرسة، ما بين الوالدين والمدرسة.....
٣. التعاون للمدرسة، ما بين الوالدين والمدرسة.....
٤. التعاون للمدرسة، ما بين الوالدين والمدرسة.....
٥. الرعاية الصحية لتفك بالإنابة بالطفل.....
٦. التكاملية في فترة الامتحانات.....
٧. ما هو النوع الأول من السكري؟.....
٨. ما هو علاج السكري؟.....
٩. ما هو اختبار سكر الدم؟.....
١٠. أهمية السكري.....

١. تفهم المدرسة لاجبة الطفل للقيام بالأنه التالية بناء على ما سبق:

- تحليل السكر بالدم عبر الجهاز المخصص لذلك.
- حقن الأنولين.
- تناول الوجبات الخفيفة.
- شرب الماء.
- الذهاب إلى دورة المياه.
- ممارسة جميع النشاطات المدرسية بدون تمييز.

٢. قيام الوالدين بعمل لقارات دورية مع الشخص المسؤول عن الطفل بالمدرسة لاجبة ما يحتاجه طفلهم سواء من تشغيل طارئ للخطأ العلاجية في حث إنارة الفرصة لفرج الأمثلة وإيجاد الحلول والحوار البناء لمعرفة مدى استعداد المدرسة للتعامل مع الطفل المصاب بالسكري من أجل تأمين بيئة تعليمية صحية للطفل وذلك هو الهدف الأممي للمدرسة.

٣. عدم تمييز الطفل المصاب بالسكري عن غيره من أقرانه من أجل تجنب أي مشاكل نفسية جراء ذلك بل يجب تشجيعه على الاندماج مع أقرانه متى ما شعر المعلم بالعدالة.



### التعاون المشترك ما بين الوالدين والمدرسة:

يتم ذلك عبر القيام بالأمور التالية:



١. إبلاغ المدرسة بزيادة الوعي لديها بجمع المعلومات اللازمة عن حالة الطفل الصحية والتي تمكن المدرسة من خلالها من القيام بالإجراءات اللازمة عند الحاجة.

وتوثيق تلك المعلومات بتقرير مفصل يتم مناقشته وشرحه للشخص المبني المتاسب سواء كان ذلك مدير المدرسة أو المعلم لياشرلو المشرف الطلابي أو طبيب المدرسة والمعرض إن وجنا ويشمل ذلك التالي:

- تشخيص حالة الطفل الصحية بإصابته بداء السكري من النوع الأول.
- تعريف ميعط عن داء السكري من النوع الأول.
- نوع الأنولين الذي يتناوله الطفل وأوقات تناوله.
- تعريف ميعط عن انخفاض السكر وأرقاعه، علا ملاء وكيفية علاجه.
- أهمية استخدام إبرة الجلوكاجون وكيفية استعمالها.
- أرقام هواتف الاتصال في حالات المفارئة وشمل: أرقام هواتف الوالدين، وفريق الرعاية الصحية، والمستشفى المتكف بالإنابة بالطفل.

## التعاون المشترك ما بين الوالدين والطفل نفسه:

يتم ذلك عبر تحضير الطفل نفسياً وجسدياً للذهاب إلى المدرسة من غير الشعور بالخوف أو القلق أو حتى الشعور بالتمييز عن غيره من أقرانه بالمدرسة ويتم ذلك عبر القيام بالأمور التالية:

- في البداية على الوالدين عدم نقل شعورهما بالخوف أو القلق عند الذهاب إلى طفلهما إلى المدرسة حتى وإن شعرا حقيقة بذلك لأن ذلك الشعور ينتقل إلى طفلهما وإن كان بشكل غير مباشر مما يولد لديه هذه الثقة بالنفس.
- يجب شرح ماهية داء السكري للطفل نفسه بما يتناسب مع عمره ومستواه التعليمي وفهماته الفكرية.
- على الطفل أن يتعلم عن ارتفاع السكر وانخفاضه، علاماته وكيفية علاجه.
- على الطفل أن يمي أهمية تحليل السكر قبل القيام بالنشاطات المدرسية المختلفة مثل الرياضة البعيدة مثلاً.
- على الطفل أن يمي أهمية تناول الوجبات الخفيفة وضرورة حملها معه في حقيبة اليد.
- من المهم جداً أن يحمل الطفل بطاقة إرفاقه شريطة على أنه مصاب بالسكري، وذو العلاج الذي يتناوله، وأرقام الهواتف الخاصة بالاتصال عند الطوارئ.
- من المهم جداً كذلك أن يحفظ الطفل بعضونة صغيرة تحمل أرقام هواتف الاتصال بوالديه وفريق الرعاية الصحية بالمستشفى.

## التعاون المشترك ما بين الوالدين وفريق الرعاية الصحية المكلف بالاهتيا بالطفل:

إن تنظيم إعداد ذلك الأمر السابقة قد يدعو صعوبة عند الوالد الأولي، ولكن الإعداد الجيد لها يبدأ أولاً عبر التعاون المشترك ما بين الوالدين وفريق الرعاية الصحية والمكون من الطبيب وأخصائية التغذية الصحي وأخصائية النفسية بطبقي الوالدين والفريق الكافي حول داء السكري وكذلك الطفل نفسه بما يتناسب مع عمره ومستواه التعليمي وفهماته الفكرية. وكذلك بنزويد الوالدين بالقرير الطبي اللازم عند الحاجة والإرشادات الصحية المفروضة حول داء السكري وأرقام هواتف الاتصال عندما تستدعي الحاجة.



## التلاميذ في فترة الامتحانات:

• إن فترة الامتحانات وخاصة تلك التي تأتي في نهاية السنة الدراسية، تجعل أغلب الأمر يعيش جو الامتحان يبالغ من الترهيب والخوف فهي تخلق فشل الابن في الامتحان لأنه يحدد موقفهم في المدرس أو مصيرهم للمقبلي.

• وقد يبلغ اهتمام الأباء بالنجاح الدراسية لأبنائهم حين ينسحبهم الانضمام بالأنباء وأنفسهم كما لو كانت هذه النتائج - بنظرهم - أهم من الأبناء، حتى أن الابن نفسه يشعر أن حب والديه له مرهون بنتائجهم الدراسية مما يعرض علاقته بوالديه إلى الانهيار وعدم النيات.



• إن نظام الامتحان والذي يشمل التحضير له أولاً ومن ثم التقدم لأناته عمليتان تقترنان بتأثير كبير في أجهام التلاميذ، فالتشاهد العقلي الزائد والتقييد للقيام بالحركة واختلال نظام الراحة والنوم والذوا لاجتماعية نتيجة الإحباط بالذاكرة الطويلة يؤدي إلى الإفراط في التوتر الجهد العصبي، ويؤثر سلباً على وضع الجسم العام الذي هو في طور النمو ويؤثر على معلوماته أيضاً، إذ يختل نظام النوم وينخفض وزن الجسم وهو ما يعرف بالإنهيار الامتحاني.



## ومن العوامل المرتبطة بالإنهيار الامتحاني:

- عدم الاستعداد المسبق للامتحانات بالذاكرة اليومية والمراجعة المنتظمة للمواد الدراسية كتمتع براسي يومي.
- حصر الإجابة على أسئلة الامتحان في وقت قصير مما يسبب التوتر لدى التلاميذ على مدى فهمهم على تذكر لمادة الدراسة والإجابة على تلك الأسئلة ضمن تلك الفترة الزمنية.
- والتخفيف الاضطراب والإنهيار الامتحاني على التلاميذ يليغي أن:
- ندرز الثقة بأنفسهم وبمعلمهم والإمكانيات التي يملكونها والمتميز على طرق حلها لتزويج هذه الصفات فيهم.
- ندرز إعداد مسبقاً للامتحانات بالذاكرة اليومية والمراجعة المنتظمة للمواد الدراسية كتمتع براسي يومي.
- لا نقوم بتغيير النظام الدراسي الذي كان سائداً على مدار العام عن نظام يوم التلاميذ لأننا الامتحان.
- ندرز ونشجع الوجبات الغذائية المقدمة إلى التلاميذ وخاصة ذلك التي تحتوي على كافة الفيتامينات الضرورية للجسم.
- ندرز الأبناء على الأساليب المفضلة لإزالة التوتر والصعوبات الحياتية.

لعالج جميع الأسباب التي تجعل مستوى تحصيلهم الدراسي أقل بكثير من إمكاناتهم للجنين يوضع خطة مناسبة للتعليق عليها وهذه الأمور سيبرز ثقة الطفل بنفسه ويقدراته وذلك بـ

**المرافقة:** يجب أن يترك الأهل في البداية ماهية المشكلة التي يتعاملون معها وأن يرافيدوا طفلهم ليلا حتى يذوقوا نوع المشكلة التي يعاني منها ثم عليهم أن يفكروا بما لاحظوه والأسباب التي من الممكن أن تؤدي إلى ذلك، فهل يمكن أن تكون خلافاً في المنزل مثلاً.

### ما هو ارتفاع السكر؟

• هو ارتفاع نسبة السكر بالدم عن المعدل الطبيعي.

اعراضه:



كثرة التبول



جفاف الفم



التهيمول



الجوع



التعب



عدم وضوح الرؤية



التهيمول

### ما هو النوع الأول من السكري

• عندما يصل الطعام الذي نأكله إلى المعدة يبدأ بالتحول إلى سكر في الدم وهذا السكر هو الطاقة التي نحتاجها على اللعب والجري والدراسة.

• يحتاج السكر إلى القبول في الدم لكي يستفيد الجسم من السكر إلى داخل الجسم.

• البنكرياس هو العضو المسئول عن صنع الأنسولين، ومن غير الأنسولين سينتج السكر في الدم ولن يستفيد الجسم من السكر إلى داخل الجسم وعندما نشعر بالثقل والمرض

• لا أحد يعلم لماذا يمرض البنكرياس عن صنع الأنسولين ولكنها ليست خطأ، بل إنها مهيئة الله سبحانه وتعالى.



### ما هو انخفاض سكر الدم؟

• هو ارتفاع نسبة السكر بالدم عن المعدل الطبيعي.

اعراضه:



تعب



فقد



جوع



دوار



عصبية



رجفة



عدم وضوح الرؤية



تعب وإرهاق



صعاع



تسرع دقات القلب



ومن الممكن فقدان الوعي والوقاية لا سمح الله.

الأسباب:

• زيادة كمية الأكل أو تناول كميات كبيرة من الأطعمة للحلاوة أو النعنية.

• أخذ كمية غير كافية من العلاج أو نسيانه أو القاء بعض الجرعات.

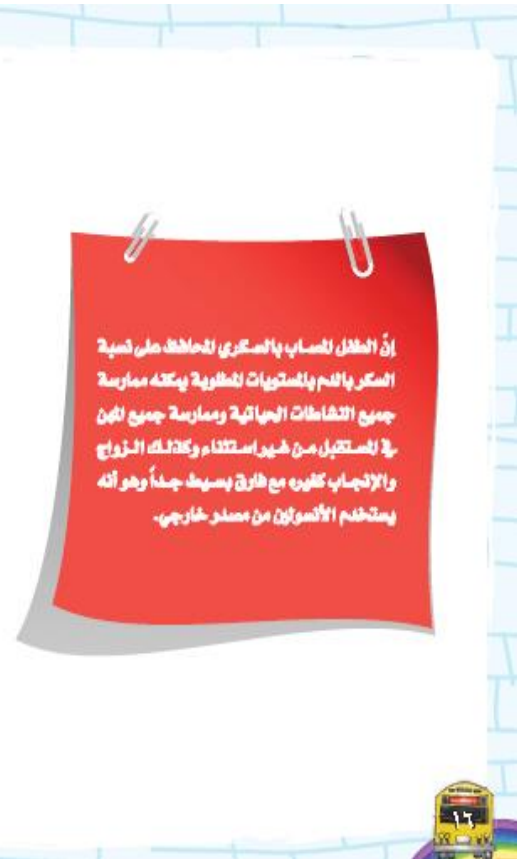
• الإصابة بالتهابات أو خروج أي مرضى على مرض كالزكام.

علاجه:

• شرب الماء والسوائل غير الحلاوة.

• أخذ الدواء بانتظام.

• البحث عن الأسباب والاتصال بالطبيب أو أخصائي التغذية الصحي عندما لا تستطيع تنظيم نسبة السكر بالدم لأخذ النصيحة.



### الوقاية:

- تناول الوجبات في أوقاتها المحددة و بكميات محددة.
- أخذ الاحتياطات عند ممارسة الرياضة بالتحليل و تناول وجبة خفيفة عند التروم.
- أخذ علاج السكر كما حدده الطبيب.
- إشباع أفراد العائلة والأصدقاء على أعراض انخفاض السكر وكيفية علاجه.
- يجب حمل حقن أو عصير كلاً من استخدام في حالة الانخفاض.

### الرياضة والمسكري

يجب عمل تحليل السكر بالدم قبل عمل الرياضة فإذا كانت نتيجة التحليل مسوية أو أقل من ١٢٠ ملغم يجب تناول وجبة خفيفة تحتوي على نشويات معقدة مع بروتين مثل (ساندوتش مع جبن).

إذا كانت نتيجة التحليل أكثر من ٢٥٠ ملغم فيجب عدم ممارسة الرياضة لأن نسبة السكر بالدم متزايدة عند عمل الرياضة.

### تبدأ أعراض الانخفاض

إذا كان مستوى السكر أقل من ٧٠ ملغم

### أسباب انخفاض السكر:

- تناول كمية قليلة من الطعام.
- أخذ جرعة زائدة من الأنسولين.
- إهمال تناول الوجبات في مواعيد.
- الحركة الزائدة عن المعتاد اليومي.

### علاج انخفاض السكر:

نصف كأس من العصير أو ٣ ملاعق سكر مذابة في كأس من الماء أو ملعقة من العسل.

يجب تناول وجبة صحية بعد التحكم المريع بالسكر للحفاظ على مستوى طبيعي، مثل خبز بر مع قطعة جبن قليل الدهن مع كوب حليب أو زبادي.

### **APPENDIX 3**

#### **Authorization Letter from the Saudi Ministry of Education**

## تفويض

حفظها الله

المكرمة مديرة إدارة التخطيط والتطوير

السلام عليكم ورحمة الله وبركاته :

أفيدكم أنا الباحثة / ..... ب. ثينة محمد قاسم الجهني

بأنني قد فوضت عني الأستاذة

رقم السجل المدني ..... بمهنة .....

لينوب عني في القيام بالمهام المشار إليها بعلامة ( √ ) أدناه :

( ) توقيع التعهد الخاص بالبحث .

( √ ) استلام أو تسليم أحد أو جميع متطلبات التطبيق الميداني للبحث من خطابات وأدوات بحث .

( √ ) تطبيق أداة البحث في الإدارة العامة للتربية والتعليم بمحافظة جدة ومكاتب التربية والتعليم بها والمدارس التابعة لها، ومتابعة وجمع ما تمّ تعبئته .

توقيع الباحث/ الباحثة

توقيع المفوض/ المفوضة إليه

ب. ثينة محمد الجهني

رقم الجوال :

رقم الجوال :

**APPENDIX 4**  
**Structured, Multiple-choice, Closed-ended, Self-administered Research**  
**Questionnaire (ENGLISH)**



## Primary School Teachers and Children with Type1 Diabetes

This survey is designed to assess the impacts of a health education programme on primary school teachers' knowledge of, and attitudes towards, type 1 diabetes (T1DM) in children in Saudi Arabia.

Your participation in this survey is greatly appreciated

### Section A: About you

Please **tick** the appropriate answer to the following questions.

#### 1. Age group (years):

25-34 ☐      35-44 ☐      45-54 ☐      55 or older ☐

#### 2. Sex:

Male ☐      Female ☐

#### 3. Years of Experience in teaching:

Less than 5 years ☐      5-10 years ☐      More than 10 years ☐

#### 4. School Sector

Public ☐      Private ☐

#### 5. Level of Education attained:

Diploma/professional ☐      Bachelor ☐      Postgraduate ☐

#### 6. Do you have Immediate relatives (1<sup>st</sup> degree) who have type 1 diabetes?

Yes ☐      No ☐

#### 7. Have you received training in the management and care of children with type 1 diabetes in the school environment?

Yes ☐      No ☐

#### 8. Do you think that you have adequate background of type 1 diabetes in children?

Yes ☐      No ☐      if **No** please go to Q10

#### 9. What are your resources for information? (Tick all appropriate items)

TV ☐      Radio ☐      Magazine ☐      Brochures ☐      Internet ☐      Public workshops ☐      booklets ☐

#### 10. Have you ever had pupils with type 1 diabetes in your class?

Yes ☐      No ☐

#### 11. Does your school have the facility to monitor the pupils with type 1 diabetes?

Yes ☐      No ☐

#### 12. Does your school have a health specialist to deal with children with type 1 diabetes in emergency cases?

Yes ☐      No ☐



## Section B: Knowledge of type 1 diabetes (T1DM) in children

Please **tick** the appropriate answer for each of the following questions.

No.	Statement	True	Don't Know	False
13.	T1DM is a chronic disease	√		
14.	Pancreas stop producing insulin in T1DM	√		
15.	Hyperglycaemia is indicated by blood glucose more than 7.0 mmol/L ( <b>126mg/dl</b> )	√		
16.	Hypoglycaemia is indicated by a blood glucose less than 4.0 mmol/L ( <b>70mg/dl</b> )	√		
17.	Unexplained weight loss, frequent urination and thirst are symptoms of T1DM	√		
18.	Frequent urination is a symptom of hyperglycaemia	√		
19.	Headache is a symptom of hyperglycaemia	√		
20.	Thirst is a symptom of hyperglycaemia	√		
21.	Ketoacidosis is producing ketones in the blood, due inability of glucose to enter the cells, so the cells get the energy from the stored fat	√		
22.	Ketoacidosis caused by omitting or insufficient insulin doses	√		
23.	Ketoacidosis is more common among children with T1DM than adult	√		
24.	Diabetic children with hyperglycaemia are most likely to suffer from ketoacidosis	√		
25.	Nausea is a symptom of ketoacidosis	√		
26.	Vomiting is one of the symptoms of ketoacidosis	√		
27.	Abdominal pain is a symptom of ketoacidosis	√		
28.	Confusion and Inability to concentrate is one of the symptoms of hypoglycemia	√		
29.	Excessive sweating is a symptom of hypoglycemia in diabetic children	√		
30.	Excessive hunger is a symptom of hypoglycemia in diabetic children	√		
31.	Nervousness is a symptom of hypoglycemia in diabetic children	√		
32.	Shakiness is a symptom of hypoglycemia in diabetic children	√		
33.	Dizziness is a symptom of hypoglycemia in diabetic children	√		
34.	If T1DM is not properly controlled, it could lead to significant reduction in life expectancy	√		
35.	Heart disease is a complication of T1DM	√		

No.	Statement	True	Don't Know	False
36.	Kidney failure is a complication of T1DM	√		
37.	Blindness is a complication of T1DM	√		
38.	High blood lipids is a complication of T1DM	√		
39.	Hypoglycaemia may be caused by too much insulin in diabetic children	√		
40.	Hypoglycaemia may be caused by less food intake in diabetic children	√		
41.	Hypoglycaemia may be caused by too much exercise in diabetic children	√		
42.	Unsweetened fruit juice has an effect on the blood glucose of diabetic children	√		
43.	Three hard candies are enough to treat hypoglycemia in diabetic children	√		
44.	Hyperglycaemia may be caused by too little insulin in diabetic children	√		
45.	Hyperglycaemia may be caused by omitting insulin doses in diabetic children	√		
46.	Hyperglycaemia may be caused by too much food in diabetic children	√		
47.	Hyperglycaemia may be caused by too little exercise in diabetic children	√		
48.	Drinking water contributes to the management of hyperglycaemia in diabetic children	√		
49.	Regular physical exercises help in controlling hyperglycaemia in diabetic children	√		
50.	PE teachers should be aware of blood glucose level or any symptoms noticed in their classes	√		
51.	Children with T1DM need to eat more than 3 meals a day	√		
52.	Children with T1DM should be controlled in their food to maintain normal level of blood glucose	√		
53.	Eating carbohydrate food and sweets can increase blood glucose level to be higher than normal level in child with diabetes	√		

## Section C: Attitudes towards children with type 1 diabetes

Please **tick** the appropriate answer for each of the following questions

No.	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
54.	T1DM care and management are not the responsibility of doctors only					
55.	T1DM care and management are not the responsibility of public health workers only					
56.	T1DM care and management are the responsibility of teachers when children with diabetes at school					
57.	Children with T1DM have the same rights and duties as children without diabetes					
58.	Children with T1DM are difficult to manage in the school					
59.	Children with T1DM require special attention to their eating habits					
60.	Children with T1DM require special attention while they are playing with other children (to avoid any injury)					
61.	It is necessary to measure the level of blood glucose 15 minutes after taking treatment for hypoglycaemia					
62.	Pupils who have T1DM are permitted to go the toilet whenever they need whilst classroom					
63.	It is necessary to measure the level of blood glucose if symptoms are noticed					
64.	Pupils who have T1DM are not allowed to participate in school trips					
65.	The contact detail of pupils who have T1DM should be with their teacher in case of emergency					
66.	If the child couldn't do an exam, there is another opportunity for him to do it					
67.	More information about type 1 diabetes would improve children's integration at school					
68.	Schools should have policies for supervision and performing blood glucose monitoring					
69.	Schools should provide (or make it available) a private room for insulin administration if needed					

No.	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
70.	A box must be kept in safe place for every child with T1DM with meter, strips, and some sweet					
71.	Schools should have policies for training staff to supervise and giving medicine and carrying out insulin injections					
72.	A health care plan each child with T1DM must be kept in the school to be followed when needed					
73.	School teachers need to update their knowledge about insulin therapy					
74.	Peers of children with T1DM should have opportunities for open discussion, so that they do not stigmatize diabetic children					
75.	As a school teacher I would like to receive educational material about children T1DM					

**APPENDIX 5**  
**Structured, Multiple-choice, Closed-ended, Self-administered Research**  
**Questionnaire (ARABIC)**

Appendix 5  
Arabic Questionnaire

معلمين ومعلمات المرحلة الابتدائية والتحكم في سكر الأطفال النوع الأول

تم تصميم هذا الاستبيان لقياس أثر برنامج صحي تثقيفي على مستوى معرفة وسلوك معلمين ومعلمات المرحلة الابتدائية تجاه مرض السكري النوع الأول لدى الأطفال في السعودية. مقدرين لكم حسن تعاونكم وتجاوبكم لخدمة هذا البحث.

القسم الأول : معلومات عامة

رجاء وضع علامة (✓) أمام الإجابة المناسبة

١. الفئات العمرية (العمر بالسنوات):

☐ ٣٤-٢٥ ☐ ٤٤-٣٥ ☐ ٥٤-٤٥ ☐ ٥٥ وما فوق

٢. الجنس:

☐ ذكر ☐ أنثى

٣. عدد سنوات الخبرة في التدريس:

☐ أقل من ٥ سنوات ☐ ١٠-٥ ☐ أكثر من ١٠ سنوات

٤. قطاع المدرسة:

☐ حكومي ☐ خاص

٥. المؤهل الدراسي:

☐ دبلوم (معهد معلمين) ☐ بكالوريوس ☐ دراسات عليا

٦. هل لديك قريب من الدرجة الأولى ( الوالدين والأخوة) مصاب بالنوع الأول من السكر ؟

☐ نعم ☐ لا

٧. هل سبق وأن تلقيت أي تدريب عن التحكم والعناية بالأطفال المصابين بالنوع الأول من السكر في المدرسة ؟

☐ نعم ☐ لا

٨. هل تعتقد بأنه لديك المعلومات الكافية عن سكر الأطفال النوع الأول ؟

☐ نعم ☐ لا في حالة الإجابة بـ (لا) رجاء الانتقال للسؤال رقم (١٠)

٩. ما هو مصدر معلوماتك عن سكر الأطفال النوع الأول ؟ (بإمكان اختيار جميع الخيارات المتاحة)

☐ التلفاز ☐ الراديو ☐ الجرائد ☐ المنشورات ☐ المجلات ☐ ورش العمل ☐ كتيبات

١٠. هل سبق وكان لديك طلاب مصابين بالنوع الأول من السكر في فصلك ؟

☐ نعم ☐ لا

١١. هل المدرسة مجهزة بمكان مخصص ليتمكن الطالب المصاب من قياس مستوى السكر في الدم ؟

☐ نعم ☐ لا

١٢. هل يتوفر بالمدرسة أخصائي صحي للتعامل مع الحالات الطارئة عند الأطفال المصابين بالنوع الأول من السكر؟

☐ نعم ☐ لا

القسم الثاني : مستوى المعرفة بسكر الأطفال النوع الأول :

رجاء اختيار الإجابة المناسبة بوضع علامة (✓)

ت	الشـرح	صح	لا	خطأ
١٣.	النوع الأول من السكر هو أحد الأمراض المزمنة (تلازم المصاب لبقية حياته)			
١٤.	لايفرز البنكرياس هرمون الأنسولين في النوع الأول من السكر			
١٥.	ارتفاع سكر الدم هو ارتفاع نسبة السكر في الدم بنسبة أكبر من ١٢٦ ملجم/ ديسيلتر			
١٦.	انخفاض سكر الدم هو انخفاض نسبة السكر في الدم بنسبة أقل من ٧٠ ملجم/ ديسيلتر			
١٧.	انخفاض الوزن المفاجئ، تكرار مرات التبول، والعطش المستمر من أعراض الإصابة بالنوع الأول من السكر			
١٨.	تكرار التبول أحد أعراض ارتفاع سكر الدم			
١٩.	الصداع أحد أعراض ارتفاع سكر الدم			
٢٠.	العطش من أعراض ارتفاع سكر الدم			
٢١.	عند عدم قدرة دخول الجلوكوز إلى الخلايا تقوم بحرق مخزون الجسم من الدهون لإمدادها بالطاقة اللازمة مكونة ما يُعرف بحموضة الدم الكيتونية لدى الطفل المصاب بالنوع الأول من السكر			
٢٢.	حموضة الدم الكيتونية تحدث بسبب عدم كفاية جرعات الأنسولين أو حذفها			
٢٣.	حموضة الدم الكيتونية منتشرة بين الأطفال المصابين بالنوع الأول من السكري أكثر من البالغين			
٢٤.	ارتفاع نسبة السكر المستمرة عند الطفل المصاب بالسكري يجعله أكثر تعرضاً إلى حدوث حموضة الدم الكيتونية			
٢٥.	الغثيان أحد أعراض حموضة الدم الكيتونية			
٢٦.	التقيؤ أحد أعراض حموضة الدم الكيتونية			
٢٧.	آلم المعدة والمغص أحد أعراض حموضة الدم الكيتونية			
٢٨.	التشوش وعدم القدرة على التركيز أحد أعراض انخفاض سكر الدم لدى الطفل المصاب بالسكري			
٢٩.	التعرق الشديد أحد أعراض انخفاض سكر الدم لدى الطفل المصاب بالسكري			
٣٠.	الجوع الشديد أحد أعراض انخفاض سكر الدم لدى الطفل المصاب بالسكري			

ت	الشـرح	صح	لا	خطأ
٣١.	العصبية أحد أعراض انخفاض سكر الدم لدى الطفل المصاب بالسكري			
٣٢.	رجفة الجسم والأطراف أحد أعراض انخفاض سكر الدم لدى الطفل المصاب بالسكري			
٣٣.	الدوخة أو الدوار أحد أعراض انخفاض سكر الدم لدى الطفل المصاب بالسكري			
٣٤.	عدم التحكم بالنوع الأول من السكر قد يؤثر سلباً على حياة الطفل المصاب			
٣٥.	أمراض القلب أحد مضاعفات النوع الأول من السكر			
٣٦.	الفشل الكلوي أحد مضاعفات النوع الأول من السكر			
٣٧.	العمى أحد مضاعفات النوع الأول من السكر			
٣٨.	ارتفاع الدهون في الدم أحد مضاعفات النوع الأول من السكر			
٣٩.	انخفاض سكر الدم قد يكون سببه زيادة جرعة الأنسولين لدى الطفل المصاب بالسكر			
٤٠.	انخفاض سكر الدم قد يكون سببه قلة كمية الطعام لدى الطفل المصاب بالسكر			
٤١.	انخفاض سكر الدم قد يكون سببه زيادة نسبة ممارسة الرياضة لدى الطفل المصاب بالسكر			
٤٢.	العصير الغير محلى يؤثر على نسبة السكر في الدم لدى الطفل المصاب بالسكر			
٤٣.	ثلاث قطع من الحلوى تكفي لعلاج انخفاض سكر الدم لدى الطفل المصاب بالسكر			
٤٤.	ارتفاع سكر الدم قد يكون سببه نقص جرعة الأنسولين لدى الطفل المصاب بالسكر			
٤٥.	ارتفاع سكر الدم قد يكون سببه ترك أو نسيان جرعة الأنسولين لدى الطفل المصاب بالسكر			
٤٦.	ارتفاع سكر الدم قد يكون سببه زيادة كمية الطعام لدى الطفل المصاب بالسكر			
٤٧.	ارتفاع سكر الدم قد يكون سببه انخفاض نسبة ممارسة الرياضة لدى الطفل المصاب بالسكر			
٤٨.	شرب الماء بوفرة يساعد بالتحكم في ارتفاع سكر الدم لدى الطفل المصاب بالسكر			
٤٩.	ممارسة الرياضة بانتظام تساعد بالتحكم في ارتفاع السكر لدى الطفل المصاب بالسكر			
٥٠.	يجب أن يكون معلمي ومعلمات الأنشطة البدنية على وعي بنسبة السكر وعلى وعي بأي أعراض قد تظهر أثناء حصصهم			
٥١.	يحتاج الطفل المصاب بالسكر لأكثر من ثلاث وجبات يوميا			
٥٢.	للتحكم بمستوى السكر لدى الأطفال لابد من التحكم بنوعية الوجبات للحفاظ قدر المستطاع على مستوى السكر الطبيعي في الدم			
٥٣.	تتناول الأطعمة التي تحتوي على الكربوهيدرات والحلوى يزيد من مستوى السكر في الدم ليصبح أعلى من المعدل الطبيعي لدى الطفل المصاب بالسكر			



القسم الثالث : سلوك المعلمين والمعلمات تجاه سكر الأطفال النوع الأول :

رجاء اختيار الإجابة المناسبة بوضع علامة (✓)

ت	الشـرح	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
٥٤.	رعاية الأطفال المصابين بالسكر والتحكم فيه ليست مسؤولية الأطباء فقط					
٥٥.	رعاية الأطفال المصابين بالسكر والتحكم فيه ليست مسؤولية العاملين في مجال الصحة فقط					
٥٦.	رعاية الأطفال المصابين بالسكر والتحكم فيه هي مسؤولية المعلمين أثناء تواجد الأطفال بالمدرسة					
٥٧.	الأطفال المصابين بالنوع الأول من السكر لهم نفس حقوق الأطفال الغير مصابين					
٥٨.	لا يصعب التحكم والاهتمام بالأطفال المصابين بالنوع الأول من السكر في المدرسة					
٥٩.	يحتاج الأطفال المصابين بالسكر إلى اهتمام خاص بعاداتهم الغذائية					
٦٠.	يتطلب الأطفال المصابين بالنوع الأول من السكر اهتمام خاص عند اللعب مع أطفال اخرون لتفادي اي اصابات					
٦١.	من الضروري قياس مستوى الجلوكوز في الدم بعد ١٥ دقائق من علاج هبوط السكر					
٦٢.	يُسمح للطلاب المصابين بالنوع الأول من السكر الذهاب للحمام متى ما احتاجوا أثناء الدرس					
٦٣.	من الضروري قياس مستوى الجلوكوز في الدم عند ملاحظة أحد الأعراض					
٦٤.	يُسمح للطلاب المصابين بالنوع الأول من السكر بالمشاركة في الرحلات المدرسية تحت اشراف مكثف					
٦٥.	يجب أن تتوفر بيانات وأرقام الاتصال الخاصة بكل طفل مصاب في حالات الطوارئ					
٦٦.	يُمنح الطفل الذي لم يستطيع أداء الامتحان فرصة أخرى					
٦٧.	قد تساعد المعلومات الإضافية عن النوع الأول من السكري على اندماج الأطفال في المدرسة والاحساس بالأمان بها					
٦٨.	يجب أن يكون لدى المدارس لوائح تنظم الإشراف والمتابعة لمستوى الجلوكوز في الدم لدى الأطفال المصابين					
٦٩.	يجب أن تكون المدارس مجهزة بغرفة للتحكم بالسكري وقياساته وحقن الانسولين عند الحاجة					
٧١.	يجب أن يكون لدى المدارس لوائح تنظم تدريب الموظفين على الإشراف على الطلاب المصابين بالسكر ومتابعتهم وعلى إعطاء حقن الأنسولين					
٧٢.	يجب الاحتفاظ لكل طالب مصاب بالنوع الأول من السكر باستمارة خطة للمتابعة الصحية والتصرف عند ملاحظة الأعراض وعند الطوارئ على أن					

					تعد بواسطة الطبيب المعالج	
					يجب على المعلمين تحديث معلوماتهم ومعرفة سكر الأطفال النوع الأول والعلاج بالانسولين	٧٣.
					يجب أن تتاح فرصة للنقاشات المفتوحة مع جميع الطلاب عن سكر الأطفال حتى لا يعاير الأطفال المصابين بمرضهم	٧٤.
					كمعلم في مدرسة أرغب في تلقي مواد تثقيفية عن مرض سكر الأطفال النوع الأول	٧٥.

**APPENDIX 6**  
**Research Participant Information Sheet (ENGLISH)**

### **Study title**

**The impact of a health education programme on primary school teachers' knowledge and attitudes towards Type 1 Diabetes Mellitus (T1DM) in children in Saudi Arabia**

### **Invitation**

You are being invited to take part in a research study. Participation in the research is entirely voluntary. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Contact me if there is anything that is unclear or if you would like more information.

### **Purpose of the study**

The focus of the research is to improve the contribution made by school teachers to the health and wellbeing of children with T1DM. We hope to achieve this by assessing the impact of a health education programme designed for primary school teachers. Your participation will greatly assist in achieving this aim.

### **Why I have been chosen**

You have been chosen because you are a school teacher in the target population in Jeddah city. In particular, you may have experience and knowledge of working with school children with T1DM, and your response to the health education programme will help us to gauge its effectiveness.

### **Do I have to take part?**

It is up to you to decide whether or not to take part. Your views are important and can contribute to the debate about provision for children with T1DM in Saudi Arabian schools. Participants will be recruited from 90 primary schools in Jeddah City. Your participation is voluntary and you may withdraw at any time without giving a reason, if so, this part will be removed from data.

### **What precisely will my involvement entail?**

Should you choose to take part, you will be asked to complete and return questionnaires about your knowledge and attitudes towards T1DM in school children, your views on the school management of T1DM in children, and your attitude towards supporting children with T1DM in school. The assessment will be on three points. First assessment, when you

complete the questionnaire before the intervention. Second assessment, will be after three months from the intervention and the final will be after nine months. The intervention will take a place in your school premises. It will be a 3 hours session, includes lecture, some activities, booklet about diabetes and school and it will be ended by a discussion.

#### **Will my taking part in this study be kept confidential?**

Yes, at no point will your identity, or indeed the identity of the organisation for which you work be shown to anyone other than the academic supervisors and examiners of the research project. Your identity will be known only to the researcher and research assistants. All information collected will be kept strictly confidential.

#### **What will happen to the results of the research study?**

The research will be written up as an academic thesis and may be further disseminated for scientific benefits. It is hoped that the findings, discussion and conclusions will inform the policy and practice surrounding the management of T1DM in children in Saudi Arabian schools. The research report (but with no identifying details) will be stored in the archives at the University of Salford and will be available for inspection on request.

#### **Who is organising and funding the research?**

The research is being undertaken as part of a programme of academic study at the University of Salford leading to the award of a PhD. The study is funded by King Abdulaziz University in Jeddah and the Saudi Cultural Bureau in London.

#### **Who Do I complain to if I am unhappy about the study?**

In the first instance, you should contact my supervisor, Professor. Tony Long on his email (t.long@salford.ac.uk). You can contact the head teacher of the school.

#### **Contact for further information**

Researcher:

Buthainah M. Aljehany

Email: b.m.aljehany@edu.salford.ac.uk

Telephone: 00966-56-56-56-106

Supervisors:

Professor Tony Long, t.long@salford.ac.uk

Dr Danny Meetoo, d.meetoo@salford.ac.uk

Thank you for giving your valuable time in reading this letter.

Regards,

**Buthainah Aljehany**

PhD Candidate

School of Nursing, Midwifery and Social Care

University of Salford

England

**APPENDIX 7**  
**Research Participant Information Sheet (ARABIC)**

### عنوان الدراسة

قياس أثر برنامج صحي تثقيفي على مستوى معرفة وسلوك معلمين ومعلمات المرحلة الابتدائية تجاه مرض السكري النوع الأول لدى الأطفال في السعودية.

### دعوة للمشاركة

تمت دعوتكم للمشاركة في هذا البحث وهي تطوعية كلياً. قبل قراركم بالاشتراك من المهم جداً معرفة لماذا يتم إجراء هذا البحث وما يتضمنه. رجاء قراءة المعلومات التالية بدقة. أرجو الاتصال بي في حال عدم وضوح أي جزء ولطلب أي معلومات إضافية.

### هدف الدراسة

يركز البحث على تطوير ما يقدمه معلمي/ومعلمات المدارس الابتدائية لمساعدة الأطفال المصابين بالنوع الأول من السكر. أتمنى تحقيق ذلك بواسطة تقييم أثر برنامج صحي تثقيفي مصمم لمعلمي ومعلمات المرحلة الابتدائية. مشاركتكم في هذا البحث لها عظيم الأثر للمساعدة في تحقيق هذا البحث.

### لماذا تم اختياري؟

تم اختيارك كمعلم/ة بالمرحلة الابتدائية وأحد أفراد مجتمع عينة البحث بمدينة جدة. تحديداً، قد يكون لديك خبرة التعامل والمعرفة بالتعامل مع أطفال مصابين بالنوع الأول من السكر في مجتمع المدرسة أو قد تواجهك يوماً ما في المستقبل. مشاركتك واستجابتك لبرنامج التثقيف الصحي ستساعدنا في تقييم البرنامج.

### هل أنا ملزم بالمشاركة؟

الأمر والقرار عائد لكم الموافقة على المشاركة أو عدم المشاركة. رؤيتك مهمة جداً وبالتأكيد ستضيف للنقاش حول أهمية مساعدة هذه الفئة من الأطفال في المدارس السعودية. المشاركون تم اختيارهم من ٩٠ مدرسة ابتدائية في جدة. بإمكانك الانسحاب في أي وقت وإبلاغ الباحثة، وسيتم حذف هذا الجزء من البيانات.



## مالذي تتضمنه مشاركتي تحديداً؟

في حال موافقتكم للمشاركة

- المرحلة أولى ستم الإجابة عن استبيان عن المعرفة بالنوع الأول من السكر عند أطفال المدارس المصابين، التحكم في سكر الأطفال في المدرسة، سلوكك تجاه دعم هذه الفئة في المدرسة. سيجرى مباشرة بعد تعبئة الاستبيان برنامج التنقيف الصحي لمدة ٢-٣ ساعات ، يتخلله فيديو تنقيفي، مناقشات وأنشطة ، كتيب. سيجرى التنقيف بمقر المدرسة.

- المرحلة الثانية بعد ٣ أشهر من التنقيف، وهي إجابة بعض الأسئلة عن طريق الاستبيان.

- المرحلة الثالثة والأخيرة وهي بعد ٣ أشهر من المرحلة الثانية وأيضا هي إجابة عن بعض الأسئلة عن طريق الاستبيان.

## سرية بيانات المشاركين

سيتم حفظ جميع البيانات المقدمة لغرض البحث في سرية تامة. ولا يحق لغير طالبة البحث والمشرف الاطلاع عليها.

## الجهة الممولة لهذا البحث

الدراسة هي متطلب لاكمال بحث دكتوراه، والباحثة مبتعثة من جامعة الملك عبدالعزيز. الجهة الممولة هي جامعة الملك عبد العزيز و الملحقية الثقافية السعودية بلندن.

## لمن يتم توجيه أي شكوى

بالامكان توجيه بريد الكتروني لمشرف الباحثة. Professor. Tony Long (t.long@salford.ac.uk).

وبامكانك تقديم الشكوى لمدير/ة المدرسة.

## بيانات الاتصال لطلب معلومات اضافية

الباحثة: بثينة محمد الجهني

ايميل: b.m.aljehany@edu.salford.ac.uk

جوال: ٥٦٢١٧٢١٧٦

المشرفين:

Professor. Tony Long

ايميل: t.long@salford.ac.uk

Dr. Danny Meetoo

ايميل: d.meetoo@salford.ac.uk

مع خالص الشكر والتقدير

بثينة محمد الجهني

طالبة دكتوراه

جامعة سالفورد مانشستر

بريطانيا

**APPENDIX 8**  
**Research Participant Consent Form (ENGLISH)**

## Research Informed Consent Form



### Participant Consent Form

#### **The impacts of a health education programme on primary school teachers' knowledge of, and attitudes towards, Type 1 Diabetes Mellitus in children in Saudi Arabia**

Buthaina Aljehany: PhD Student

Name of participant: .....

#### **Please initial each statement.**

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

2. I understand that my participation is voluntary and that I am free to withdraw from the study at any time without giving any reason. I understand what will be required of me.

☐

3. I understand that my involvement and my data will remain confidential, and that only the researcher and her supervisor will have access to the data.

☐

4. I know who to contact for further information or to complain about any aspect of the study.

☐

5. I give consent to participate in this study.

☐

\_\_\_\_\_  
Name of Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name of Person taking consent

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

**APPENDIX 9**  
**Research Participant Consent Form (ARABIC)**

قياس أثر برنامج صحي تثقيفي على مستوى معرفة وسلوك معلمين ومعلمات المرحلة الابتدائية  
تجاه مرض السكري النوع الأول لدى الأطفال في السعودية

بثينة الجهني طالبة دكتوراه

رقم الاستمارة الخاص بكل معلم .....

اسم المعلم/ة.....المدرسة.....

رجاء وضع علامة (√) على جميع الخانات بعد الاطلاع

1. تمت قراءة وفهم المعلومات المقدمة عن الدراسة. تمت إتاحة الفرصة للاطلاع عليها وطرح الأسئلة  
والاجابة عنها

2. تم العلم بأن اشتراكي في هذه الدراسة تطوعيا ولي الحق بالانسحاب في أي وقت بدون ابداء اي سبب  
وعلي ابلاغ الباحثة بذلك

3. تم العلم بأن اشتراكي وبياناتي سرية تماما ويحق للباحثة والمشراف فقط بالاطلاع عليها

4. تم توفير المعلومات للاتصال بالشخص المسؤول لتقديم أي شكوى عن أي جانب من جوانب  
الدراسة

5. أقدم موافقتي على الاشتراك في هذه الدراسة

التوقيع	التاريخ	اسم المشارك
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التوقيع	التاريخ	اسم مستلم الموافقة
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**APPENDIX 10**  
**Research Ethical Approval from the University of Salford Research Ethics**  
**Committee**

27 June 2013

Dear Buthainah,

**RE: ETHICS APPLICATION HSCR13/25 – The impacts of a health education programme on primary school teachers' knowledge of, and attitudes towards, Type 1 Diabetes Mellitus in children in Saudi Arabia**

Following your responses to the Panel's queries, based on the information you provided, I am pleased to inform you that application HSCR13/25 has now been approved.

If there are any changes to the project and/ or its methodology, please inform the Panel as soon as possible.

Yours sincerely,

*Rachel Shuttleworth*

Rachel Shuttleworth  
College Support Officer (R&I)



## **APPENDIX 11**

### **Research Ethical Approval from the Saudi Ministry of Education**

الرقم : ٩٠٩ / ١ / ٢٠٢٠  
التاريخ : ١٧ / ١١  
المرفقات : بحث



الجمهورية العربية السورية

وزارة التربية والتعليم

٢٠٢٠

الإشارة العامة للتربية والتعليم بمحافظه حده

إدارة التخطيط والتطوير

البراسات والبحوث

إلى . مدير / المدرسة الابتدائية /

من . مديرية إدارة التخطيط والتطوير

بشأن . تسهيل مهمة الأياحة / بثينة محمد قاسم الجهني

والسلام عليكم ورحمة الله وبركاته ، وبعد .

إشارة إلى إحالة سماعة المدير العام للتربية والتعليم بمحافظه حده ني الرقم ٢٤١٢٣٦٤٦١ وتاريخ ٢٤/٧/٢٠٢٠ اه بشأن تسهيل مهمة الميمنة من جامعة الملك عبدالعزيز الأياحة/ بثينة محمد قاسم الجهني في بحثها بعنوان تأثير برنامج تثقيف صحي عن سكر الأطفال النوع الأول على مستوى معرفة معلمين ومعلمات المرحلة الابتدائية عن هذا المرض في مدينة حده كمدتطلب لكميلي للحصول على درجة الدكتوراه في تخصص صحة الأسرة والطفل من جامعة سالفورد مانشستر ببريطانيا ، ولرغب الباحثة في تطبيق أبحاث بحثها (برنامج تثقيفي صحي) و (استبيان) قبل وبعد البرنامج على عينة من المعلمين والمعلمات بالمرحلة الابتدائية في مدينة حده حيث تم فحص أداة البحث وتبين استيفائها ضوابط الوزارة بهذا الخصوص .

نأمل منكم تسهيل مهمة الأياحة بمدارس الكينات ومندوبها لدى مدارس الكينين بتعريفها من

تطبيق أدوات البحث بمدارسكم .

شاكرين ومقدرين تعاونكم واهتمامكم بالبحث العلمي .

والسلام عليكم ورحمة الله وبركاته

وسيلة بنت عمر باموسى

مديرة إدارة  
التخطيط والتطوير

١٧ / ١١ / ٢٠٢٠



مطلع ١٧

**APPENDIX 12**  
**Kids and Diabetes in Schools Programme (KiDS)**

## Kids and Diabetes in Schools (KiDS) Project (IDF, 2014)

Retinopathy is one of the most common complications associated with diabetes and one of the major causes of adult blindness. Up to 11% of adults with diabetes have Diabetic Macular Edema (DME), a specific type of diabetic retinopathy.

The project is expected to be completed by December 2015 and will culminate in the production of a barometer report and a compendium of resources designed to increase awareness, as well as to inform policy and practice related to diabetic retinopathy and vision loss across countries.



### Kids and Diabetes in Schools (KiDS)

The Kids and Diabetes in Schools (KiDS) project is helping to foster better care and understanding of diabetes in the school environment. Launched in 2013 in collaboration with the International Society for Pediatric and Adolescent Diabetes (ISPAD) and with the support of Sanofi Diabetes, the project seeks to educate teachers and those who interact with children at school about type 1 and type 2 diabetes.

The main deliverable of the project is a Global Diabetes Information Pack for school staff and children, providing information on diabetes prevention and management.

The pilot phases took place in Brazil and India where adaptations of the pack were made to meet cultural and local needs. The pack has been disseminated in 15 schools in each of the pilot countries, in collaboration with ministries of health and education, school and parent representatives. Using training workshops of teachers, in-school activities and social media, the long-term objective is to make the Global Diabetes Education Pack an accessible tool for all schools. It is currently available in nine languages with more on the way.

KiDS was launched in India in July 2014 by the Public Health Foundation of India (PHFI) and Health Related Information Dissemination Amongst Youth (HRIDAY). 15 schools (both government and private) received training sessions and information packs on managing diabetes from experts in healthcare, public health and health promotion from. The packs include interesting extra-curricular activities to engage children on the issue. It is estimated that education sessions and information about diabetes reached approximately 40,000 students, teachers and families during the year.

